CIVIL / STRUCTURAL ENGINEERING

CAREER PATH FROM THE FUTURE TO THE PRESENT

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Structural | Shoring | Civil Engineers

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LABIB FUNK & ASSOCIATES

UCLA online Seminar
CEE 1
2021.10.15

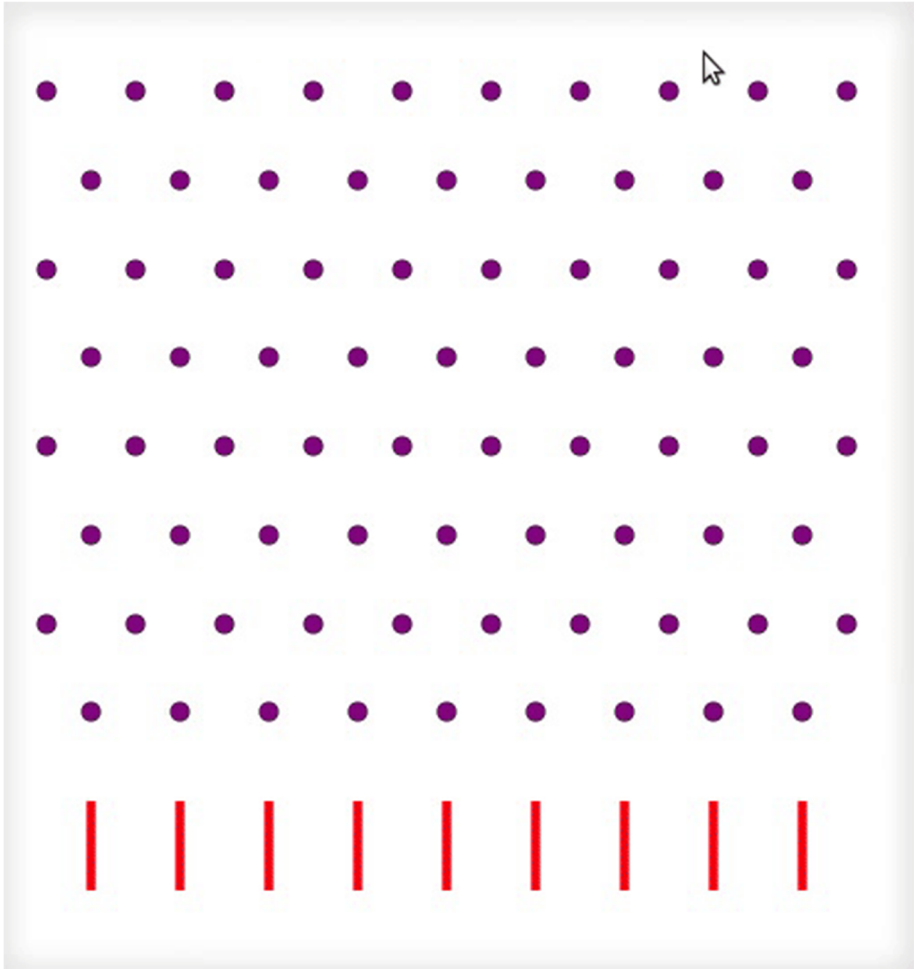
AND YOU ARE?

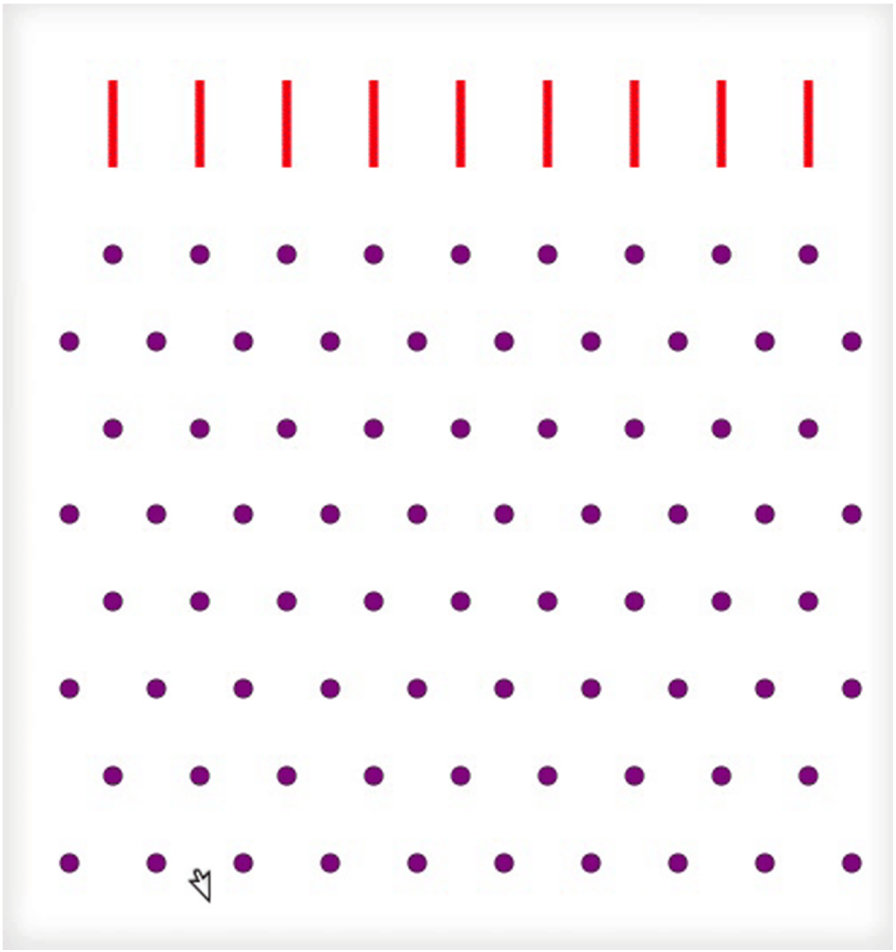
- I am you (probabilistically)
- From the future
- Here to share a glimpse of possibilities
- Derived from a shared experience
- With actionable information


UC San Diego

ROSSETTI

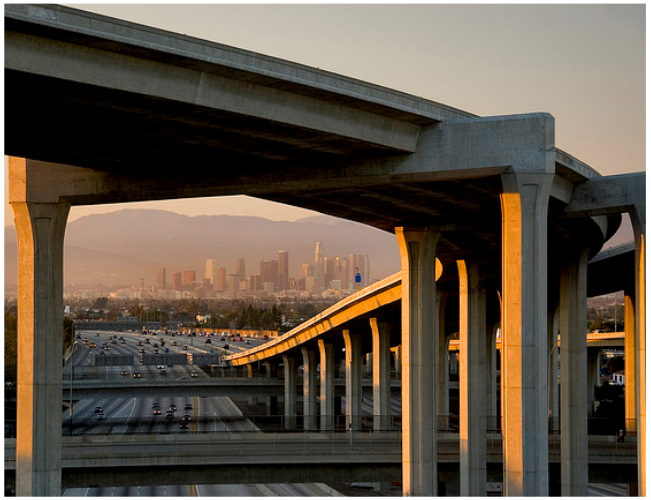

LOS ANGELES CLIPPERS
LOS ANGELES
CLIPPERS





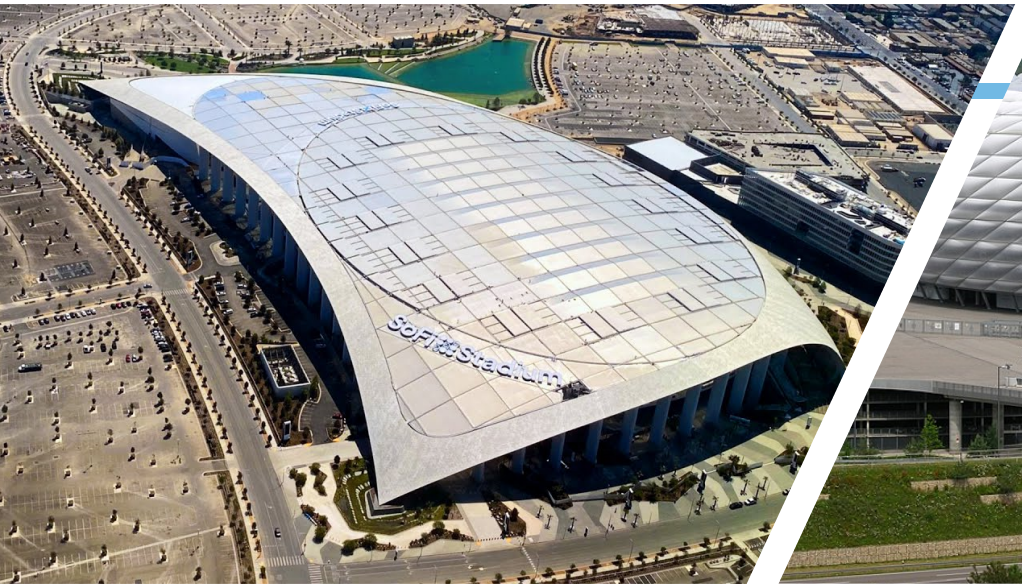
CIVIL ENGINEERING BRANCHES

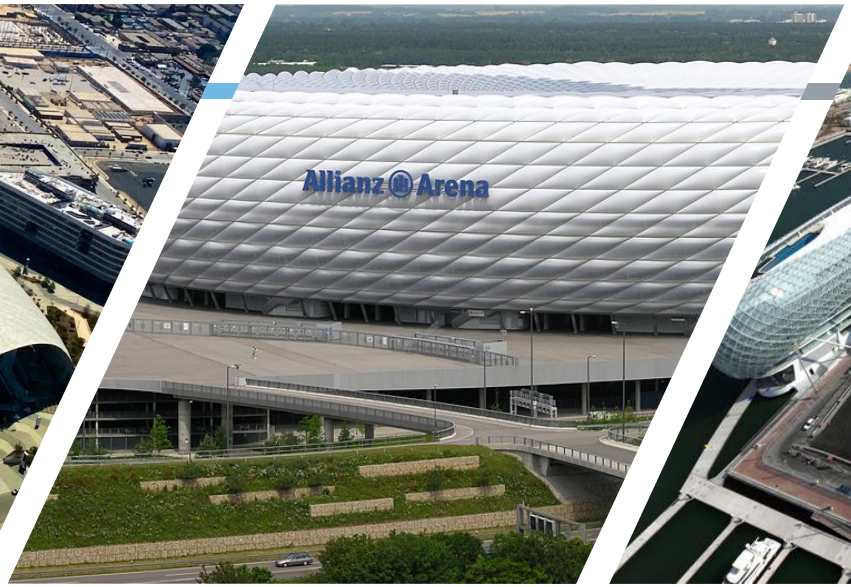
- General Civil
- Transportation
- STRUCTURAL
- Geotechnical
- Construction (Management)
- Environmental
- Water Resources
- Solid Waste & Wastewater

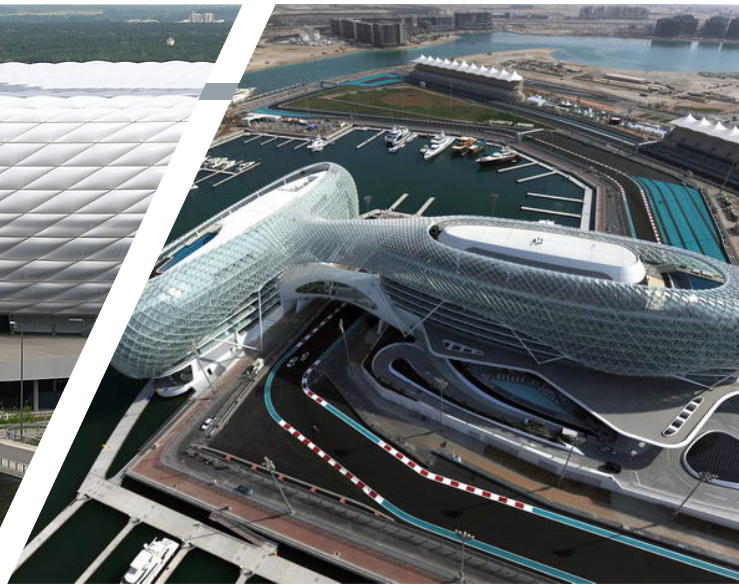


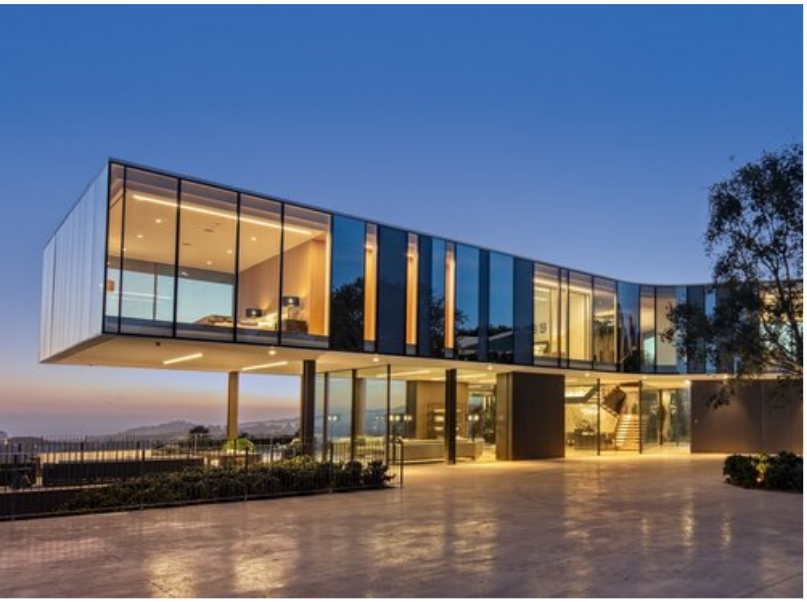






SoFi Stadium


Allianz Arena



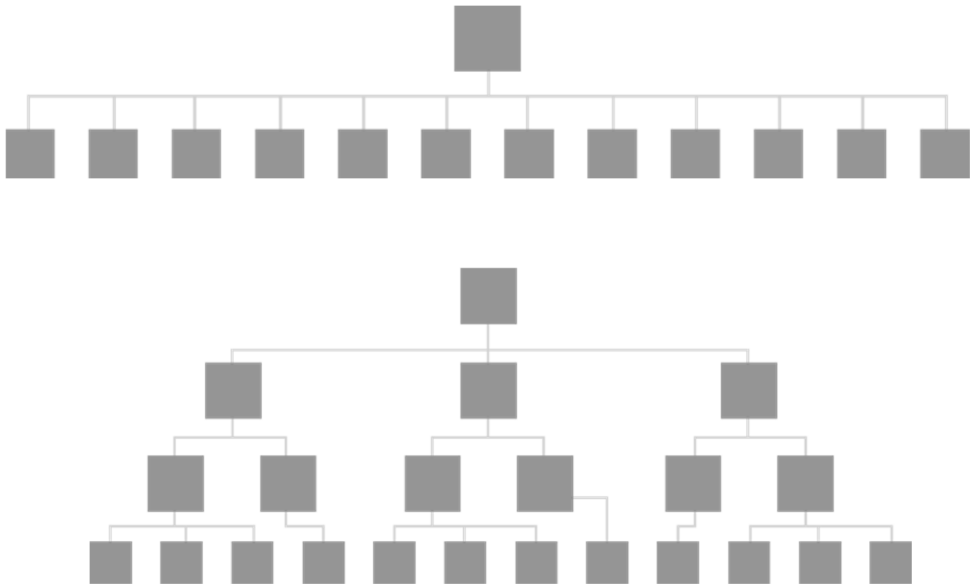


CAREER PATHS

- Engineer (Private or Public)
- Jurisdiction – Plan Check Engineer
- Institution – Facilities Manager
- Academia
- Product Development / Sales (Structural Technologies)
- Construction
- Software Development
- Many others

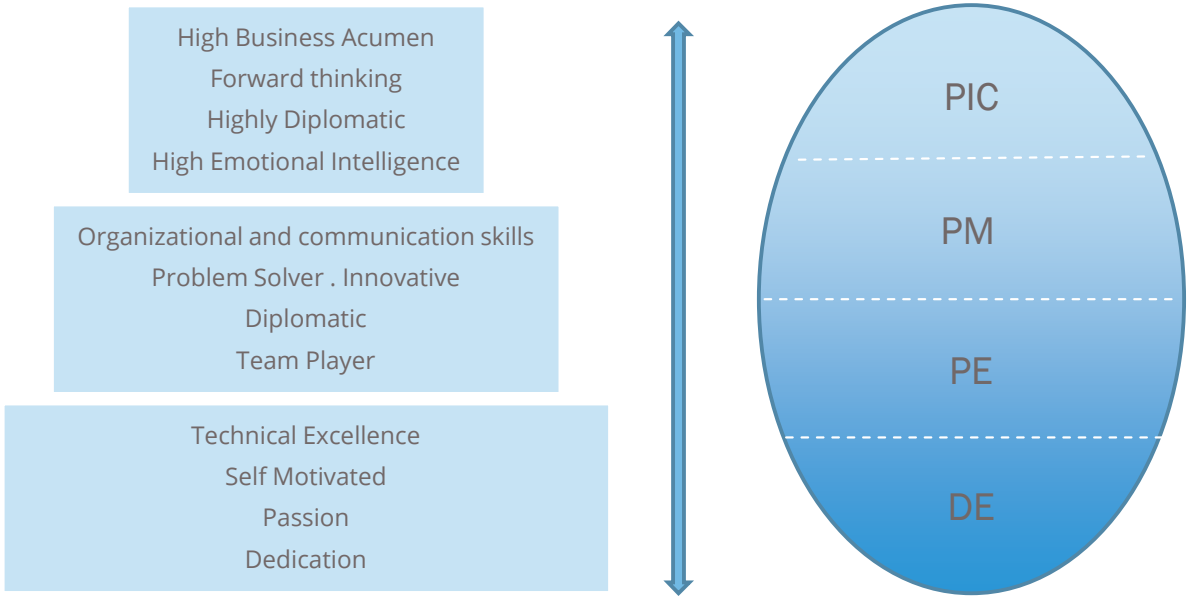
ORGANIZATIONAL STRUCTURES

- None
- Flat
- Hierarchal
- Multi-Office (non) Centralized



POSITIONS & SKILLSETS

- Owner
- Principal in Charge - PIC
- Project Manager - PM
- Project Engineer - PE
- Design Engineer - DE



POSITION ROLES

OWNER

- Get Work!
- Lead Principals
- Manage Accounting
- Manage Admin
  - Insurance
  - Human Resources
  - Regulatory Compliance
- Plan Ahead . Anticipate & React to Market Conditions
- Manage some projects

PRINCIPAL IN CHARGE

- Get Work!
- Main Client Contact for Executive Decisions
- Lead Project Managers
- Manage billing / invoicing for own projects
- Oversee Executive Decisions
- Risk Management
- Education
- Recruiting . Interview
- Personnel Issues
- Many other Tasks

POSITION ROLES [CONT.D]

PROJECT MANAGER

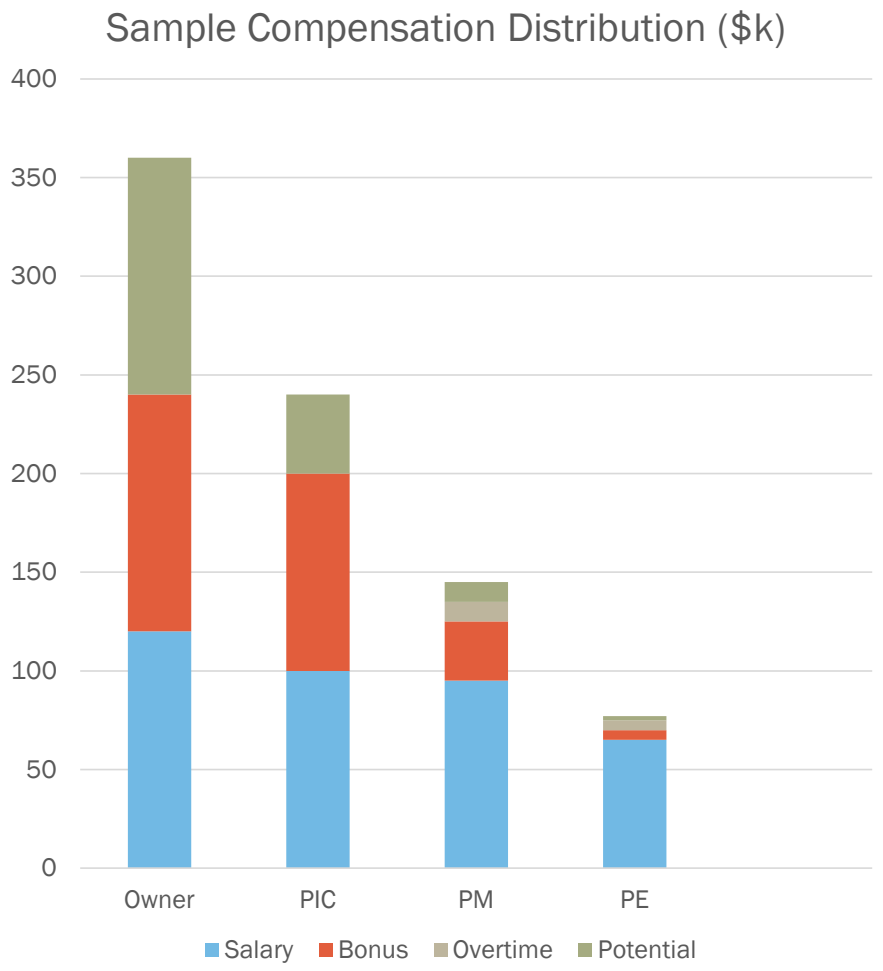
- Service . Manage Clients
- Schedule . Allocate the Work
- Executive Designer
- Lead engineering team
- Manage billing / invoicing for own projects
- Collaborate with other PM's
- Delegate . Train . Mentor . Feedback
- Try to get Work!

PROJECT . DESIGN ENGINEER

- Get work done!
- Learn in the process
- Self development
- Manage own time on multiple projects
- Look ahead and emulate

COMPENSATION

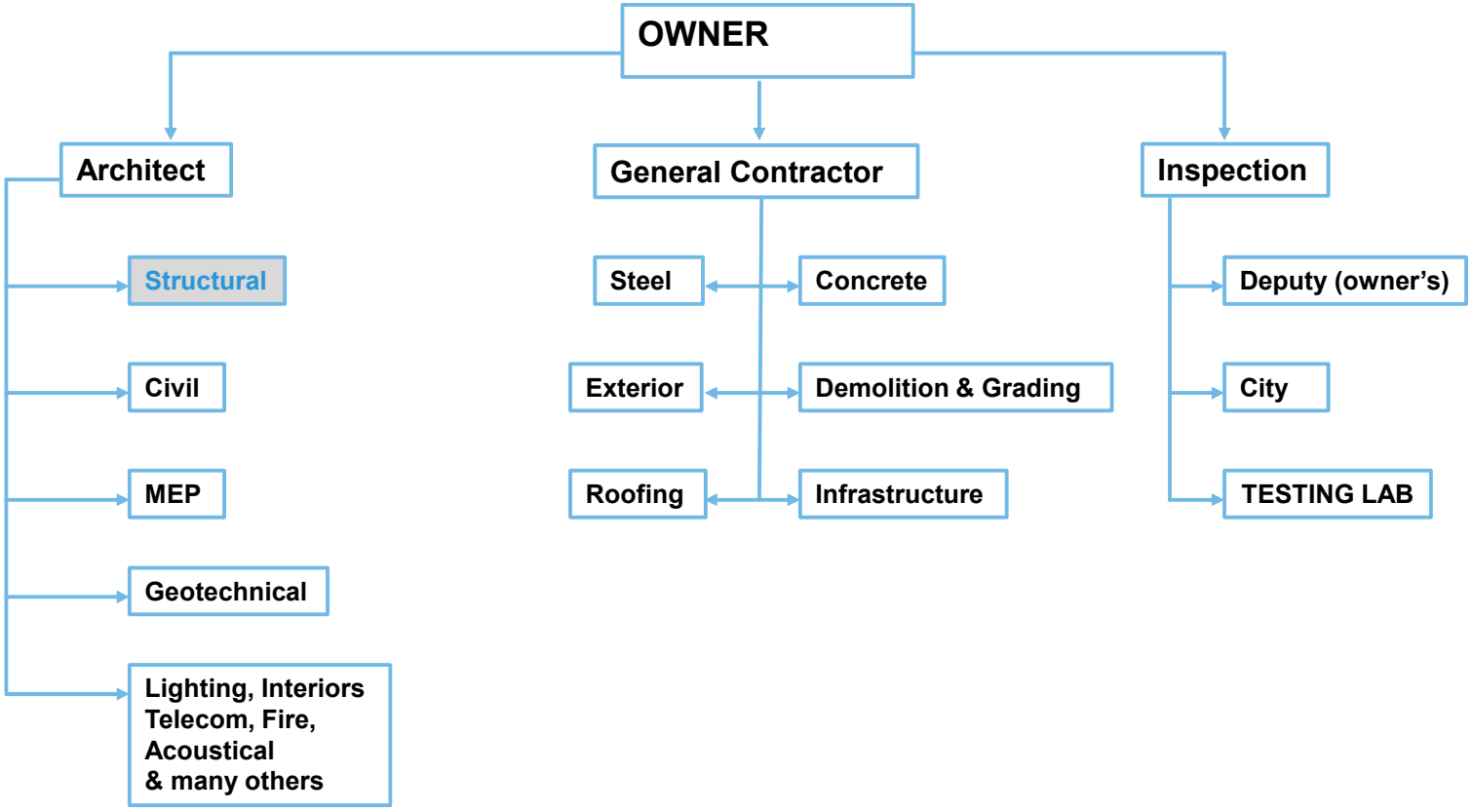
- Changes over time to be more incentive / bonus Based
  - Entry Level – Mainly Salary . Small Bonuses
  - PM – ½ Salary ½ Bonus (roughly)
  - Owner / Principal – Small Salary . Mostly Bonus
- Salary
  - Region
  - Size of Firm
  - Type of Work (Funding Source)
  - Economy ($50k - $80k+, $300k+, $1M+)
- Bonus
  - Depends on model
  - 2% - 15%



TYPICAL BENEFITS & COMPENSATION

- Salary
  - Region
  - Size of Firm
  - Type of Work (Funding Source)
  - Economy ($50k - $80k+, $300k+, $1M+)
- Bonus
  - Depends on model
  - 2% - 15%
- 401k – None / Offered / Funded / Matching
- Profit Sharing (deferred bonus)
- Long Term Incentive w/ Maturation
- Ownership – Many models including:
  - Employee = Owner
  - No ownership transition
- Consider Cost of Living Index (LA vs SF ~ 15-20%)
- Consider Commute Time / Cost

DESIGN / CONSTRUCTION TEAMS



PROJECT PHASES

Design

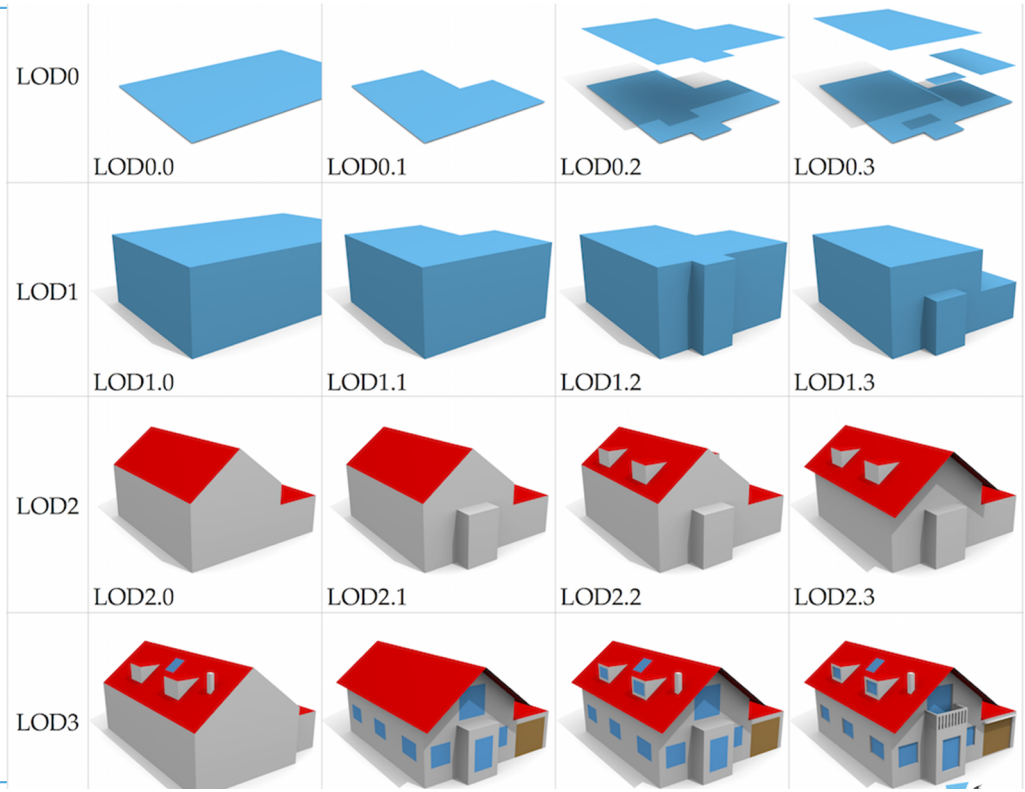
- Concept
- Schematic Design – SD
- Design Development - DD
- Construction Documents - CD

Bidding & Approval

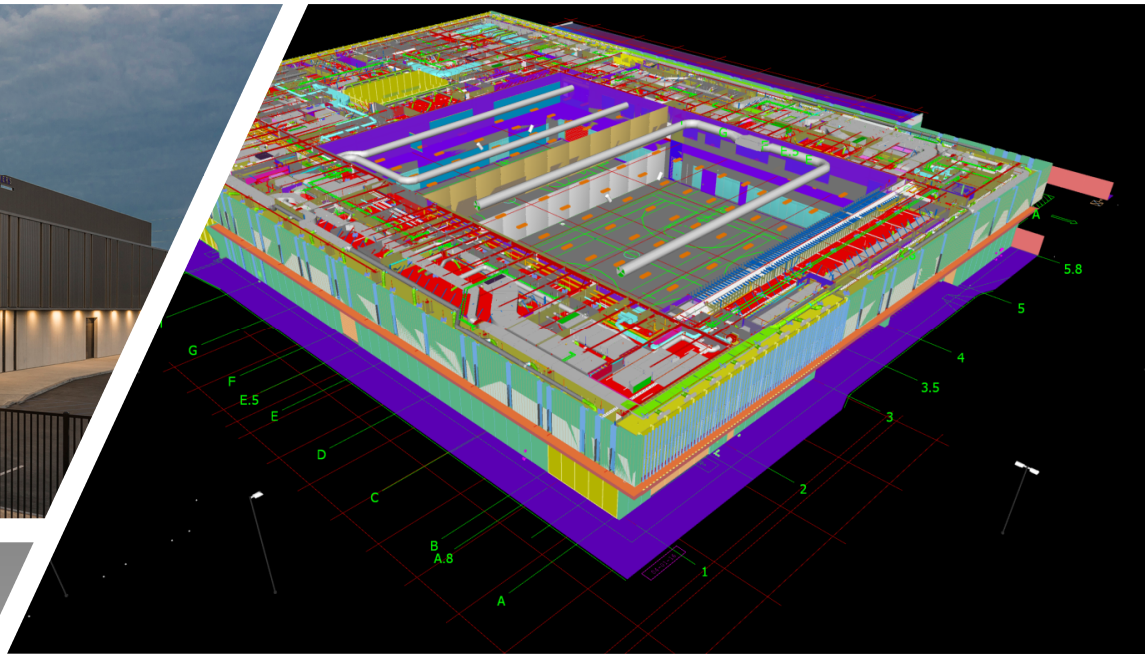
- Jurisdictional Plan Review
- Bidding Process

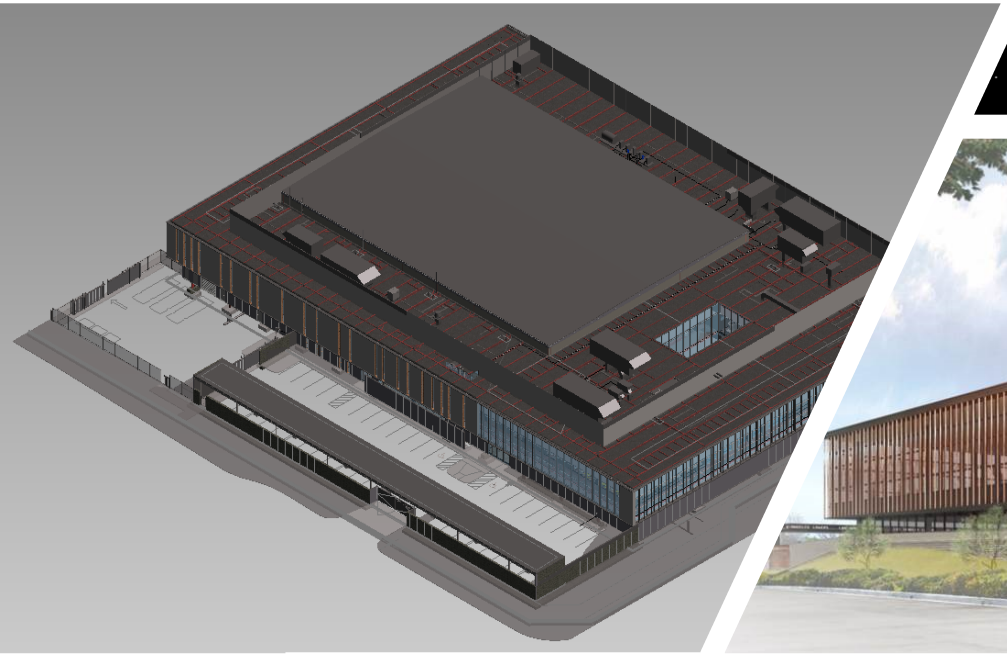
Construction Administration

- Submittals (shop drawings)
- Requests for Information
- Site Visits

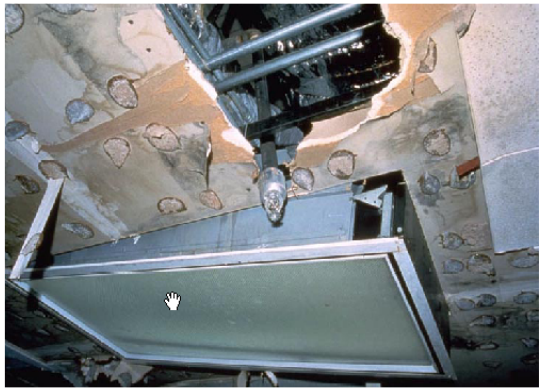


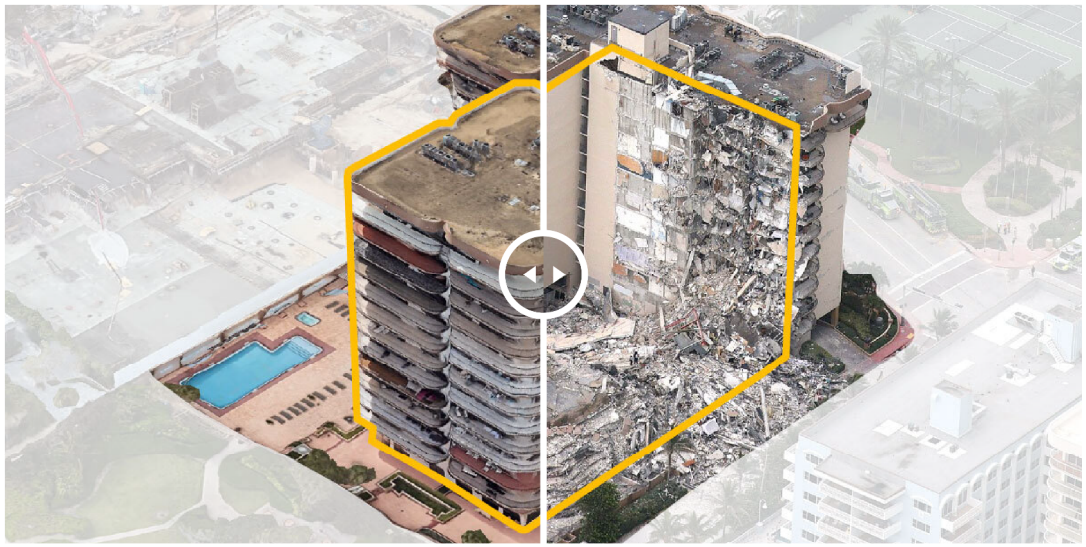

UCLA HEALTH TRAINING CENTER

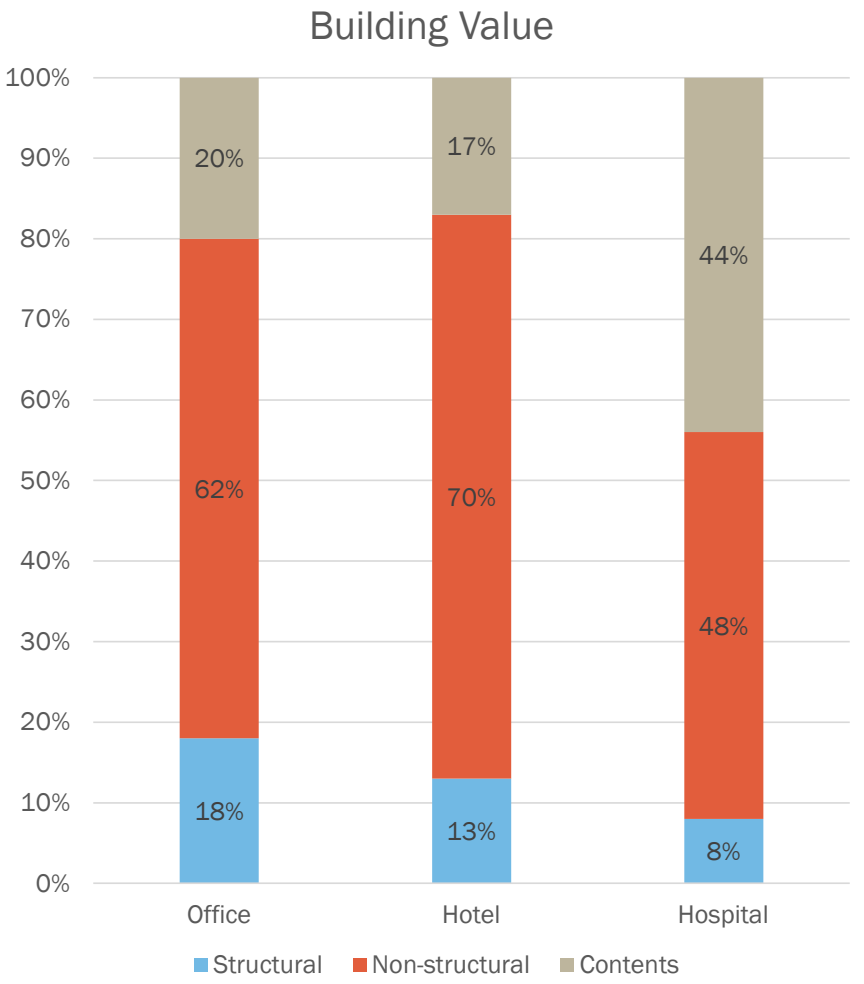

G
F
E.5
E
D
C
B
A.8
A
1
2
3
4
5
5.8
3.5

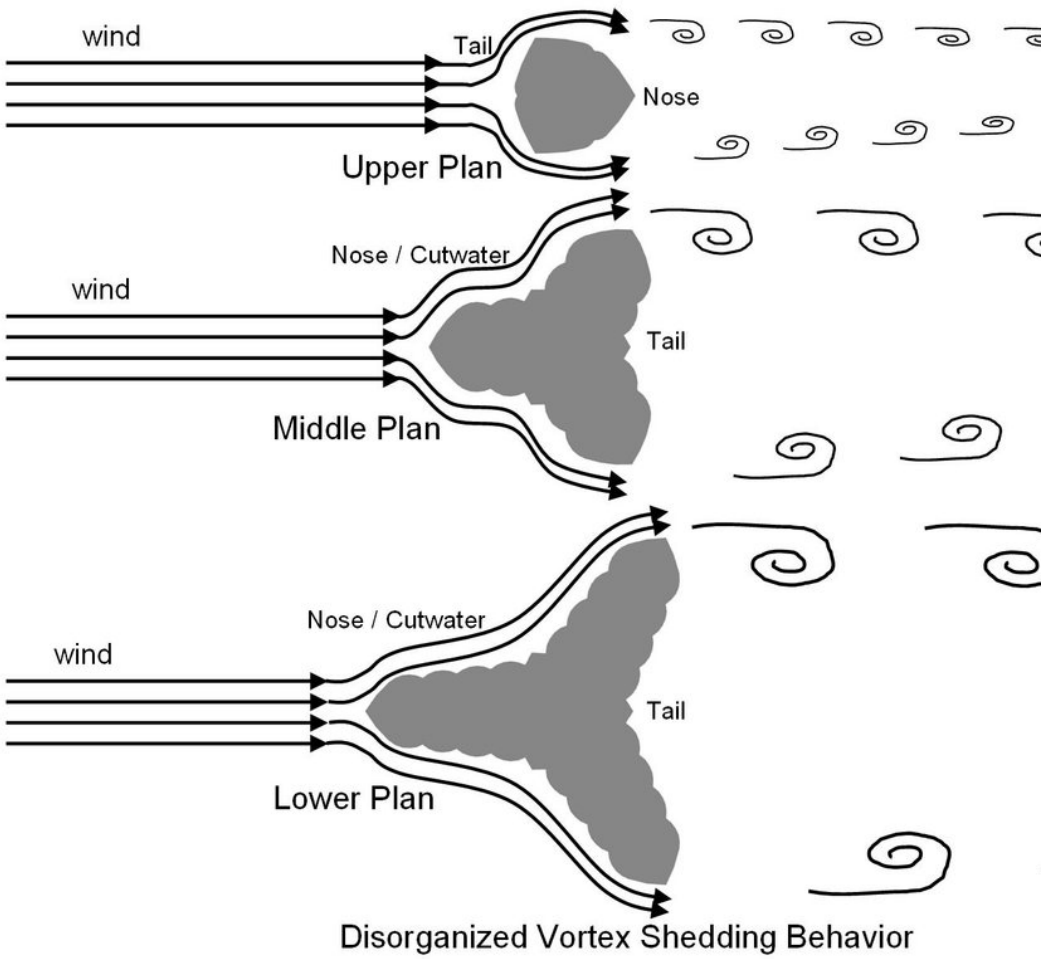


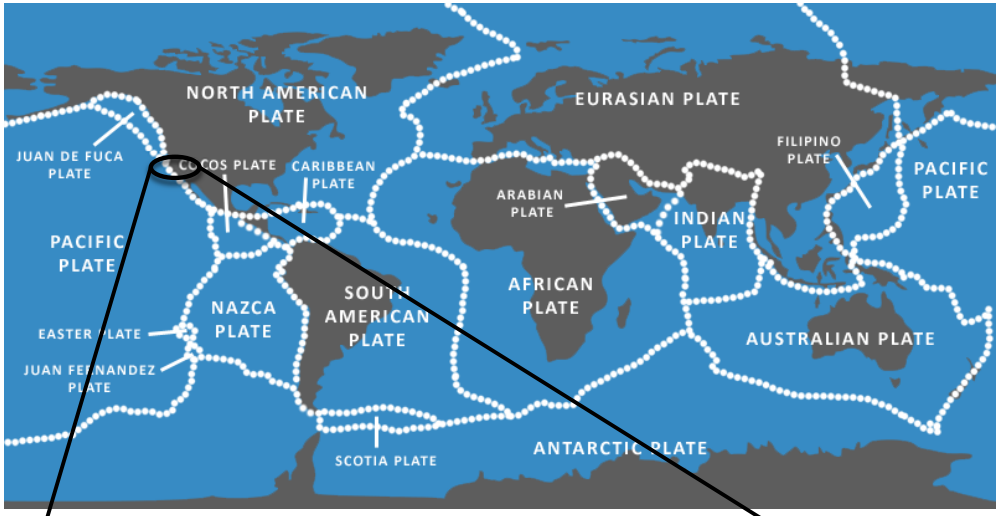

LOS ANGELES
LAKERS
HOME OF THE LOS ANGELES LAKERS

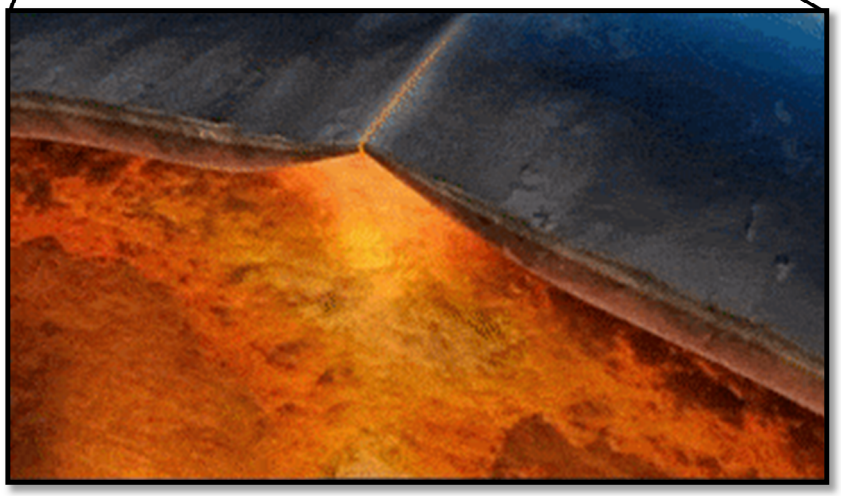


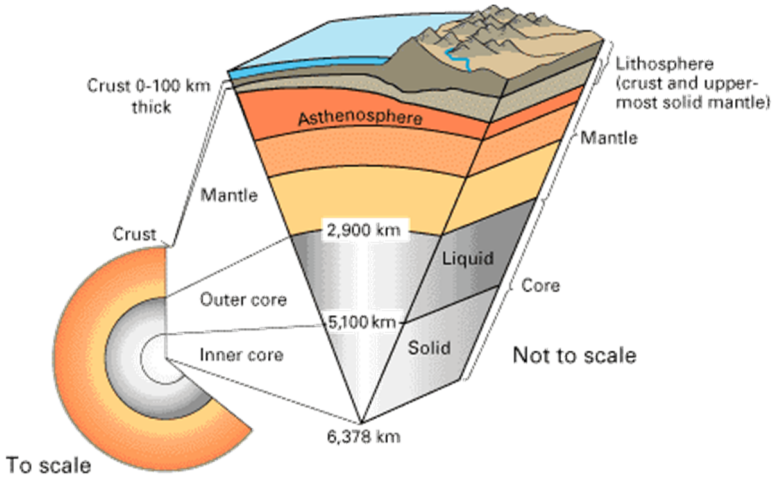


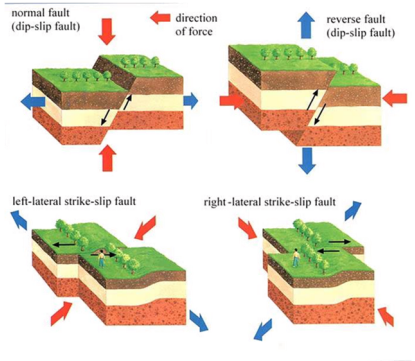

Building Value
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
20%
62%
18%
17%
70%
13%
44%
48%
8%
Office
Hotel
Hospital
Structural
Non-structural
Contents

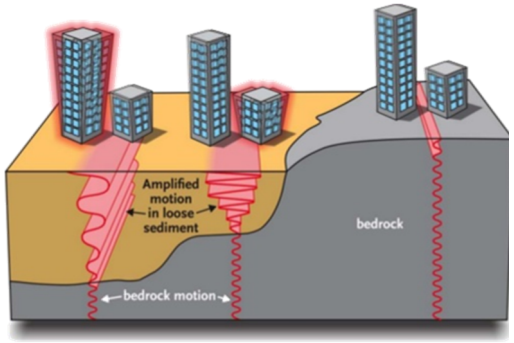

wind
Tail
Nose
Upper Plan
Nose / Cutwater
wind
Tail
Middle Plan
Nose / Cutwater
wind
Tail
Lower Plan
Disorganized Vortex Shedding Behavior


NORTH AMERICAN PLATE
EURASIAN PLATE
JUAN DE FUCA PLATE
COCOS PLATE
CARIBBEAN PLATE
FILIPINO PLATE
PACIFIC PLATE
ARABIAN PLATE
INDIAN PLATE
PACIFIC PLATE
NAZCA PLATE
SOUTH AMERICAN PLATE
AFRICAN PLATE
EASTER PLATE
AUSTRALIAN PLATE
JUAN FERNANDEZ PLATE
SCOTIA PLATE
ANTARCTIC PLATE

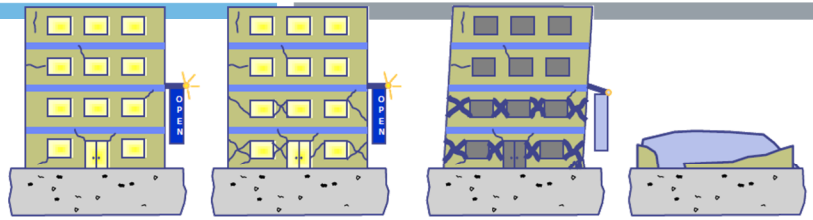


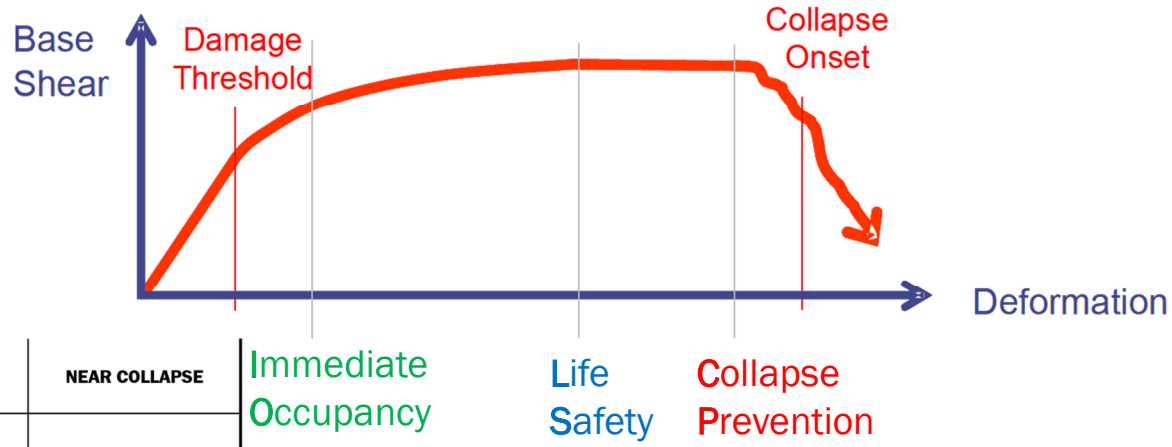

Crust 0-100 km thick
Lithosphere (crust and upper-most solid mantle)
Asthenosphere
Mantle
Mantle
Crust
2,900 km
Liquid
Core
Outer core
5,100 km
Solid
Inner core
Not to scale
6,378 km
To scale

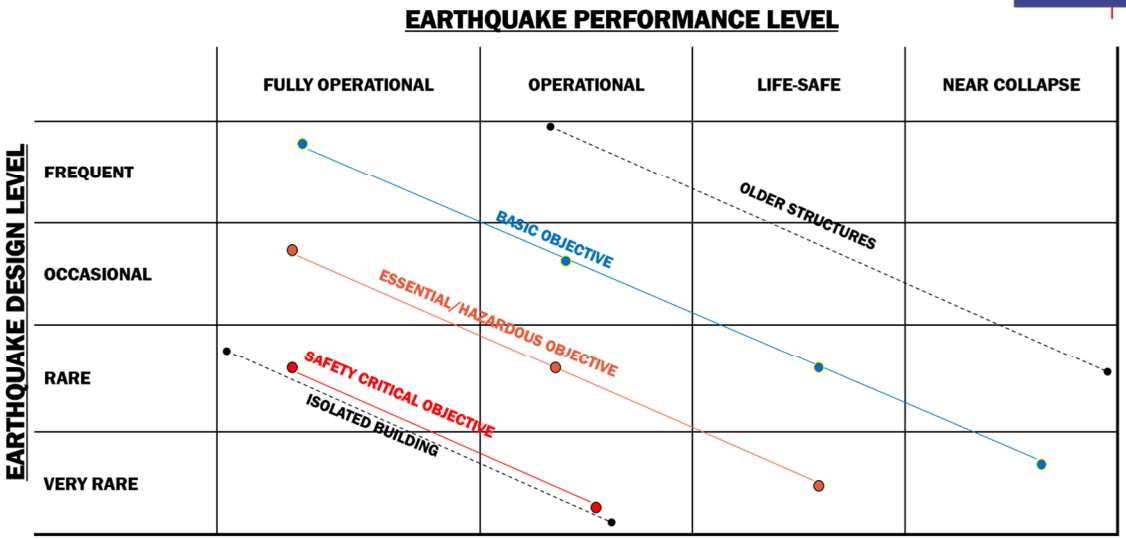

normal fault (dip-slip fault)
direction of force
reverse fault (dip-slip fault)
left-lateral strike-slip fault
right-lateral strike-slip fault


Amplified motion in loose sediment
bedrock
bedrock motion

PERFORMANCE OBJECTIVES

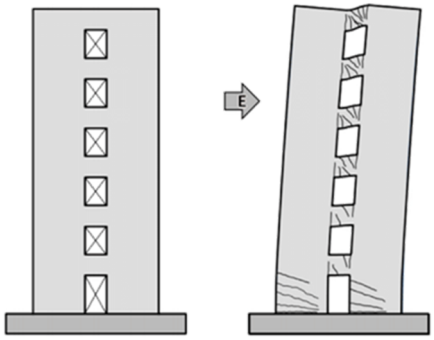






STRUCTURAL SYSTEMS . CONVENTIONAL

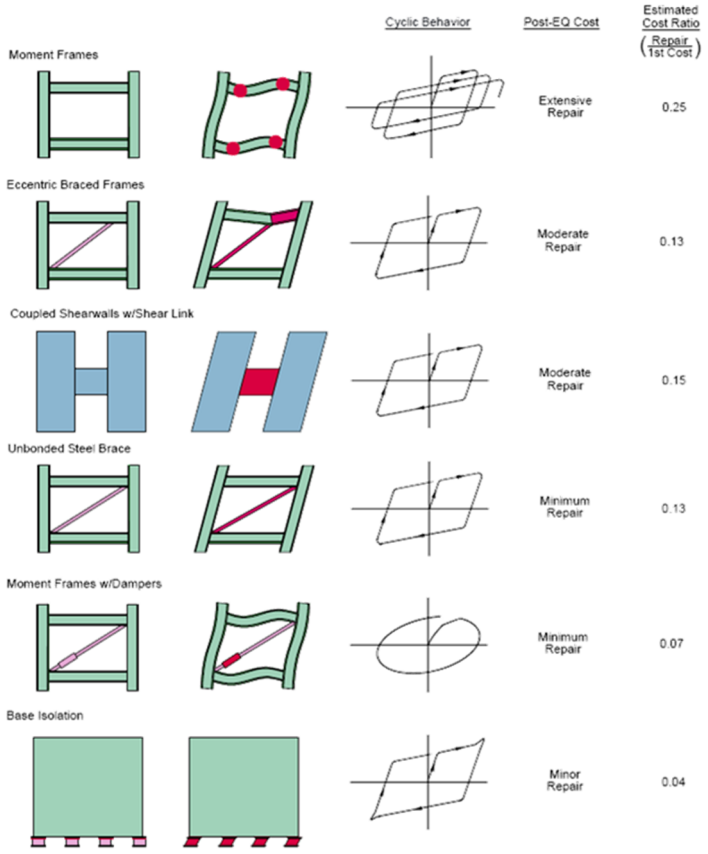
Moment Frames



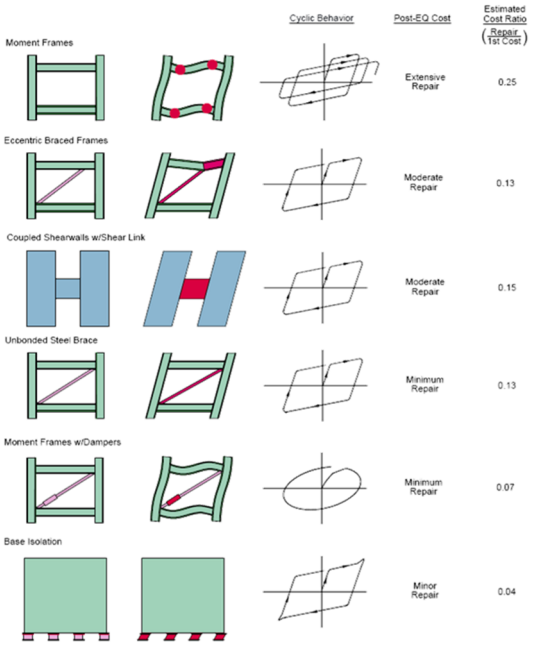
Shear Walls

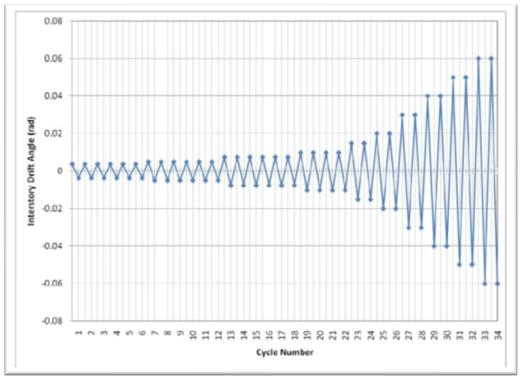
Braced Frames

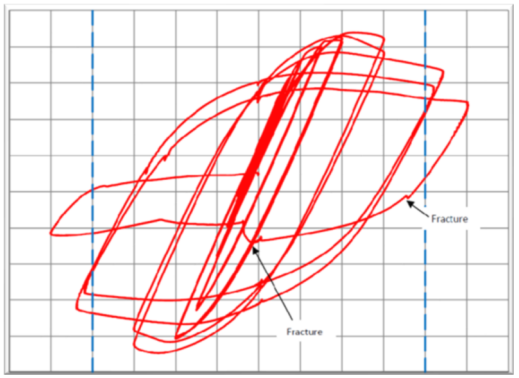
Energy Dissipating Mechanism

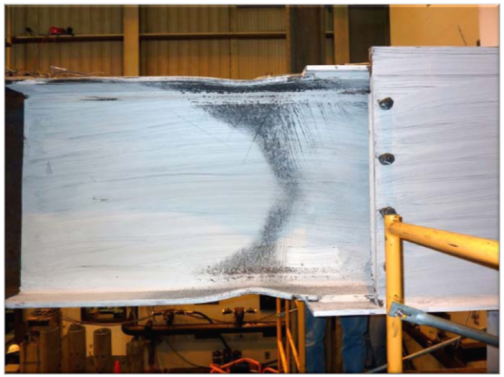


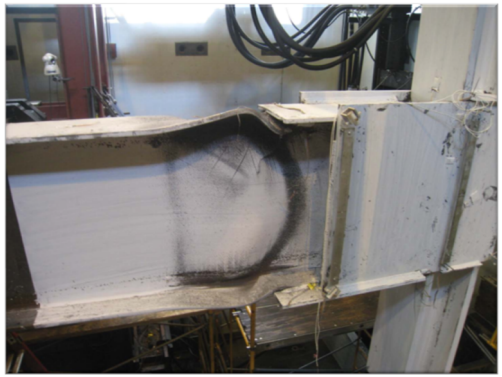
COMPONENT TESTING



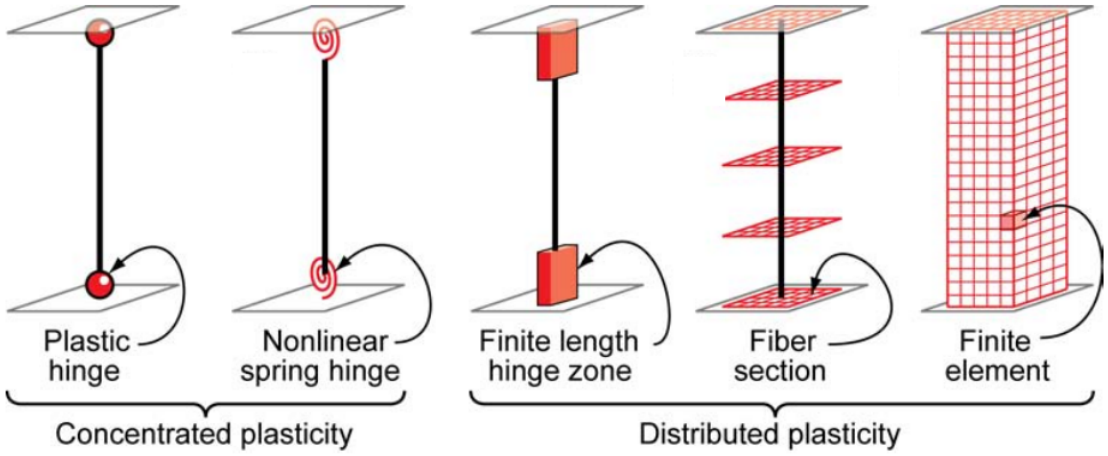


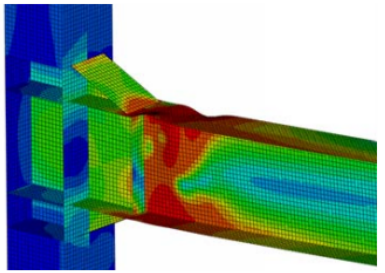


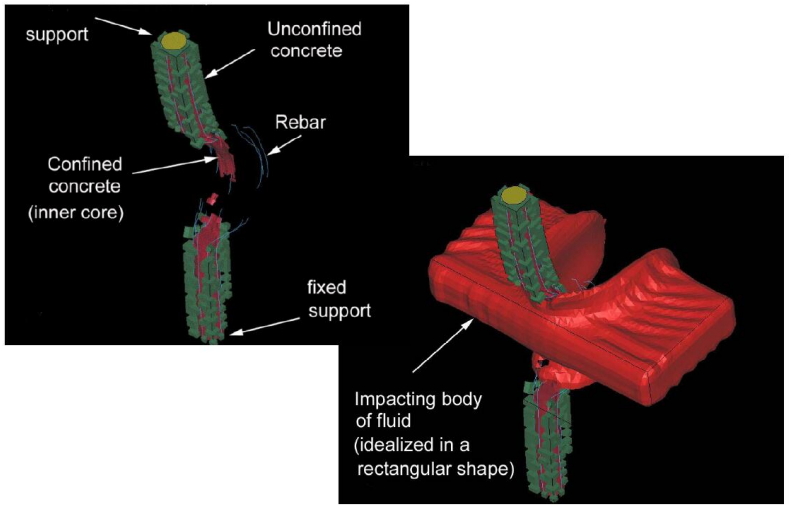




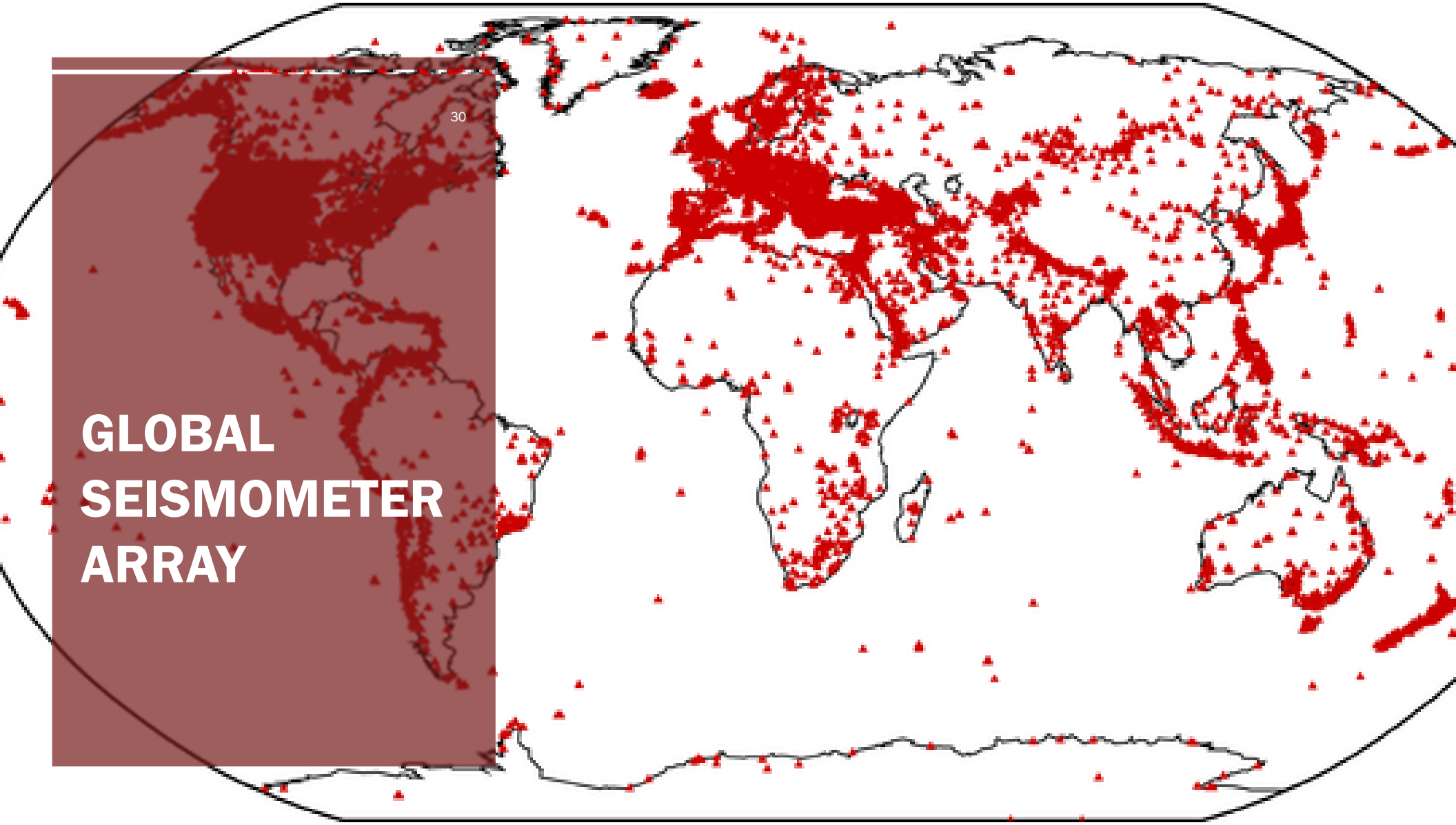
NONLINEAR ANALYTICAL MODELS FRAME ELEMENTS

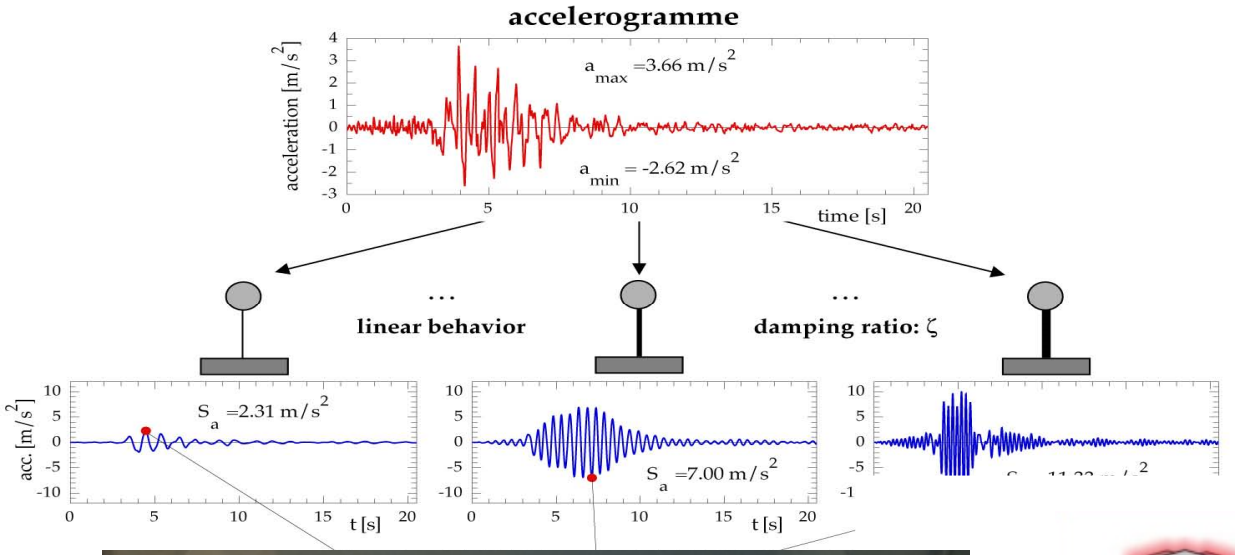




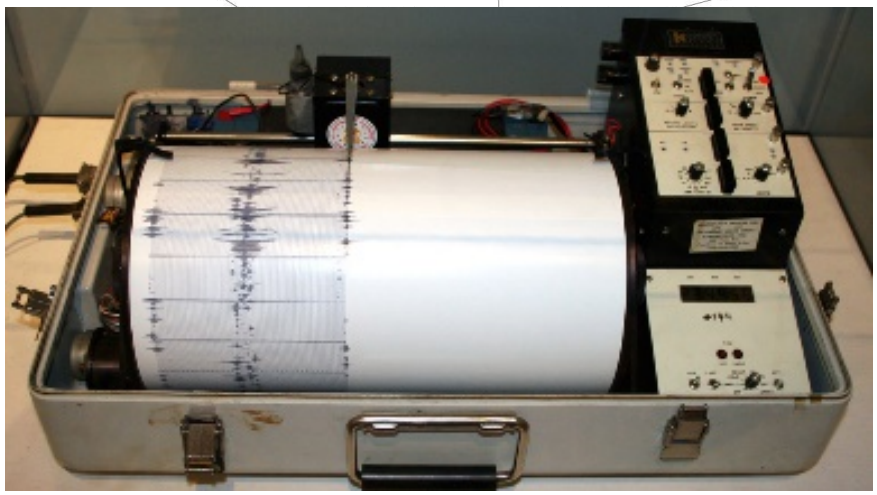


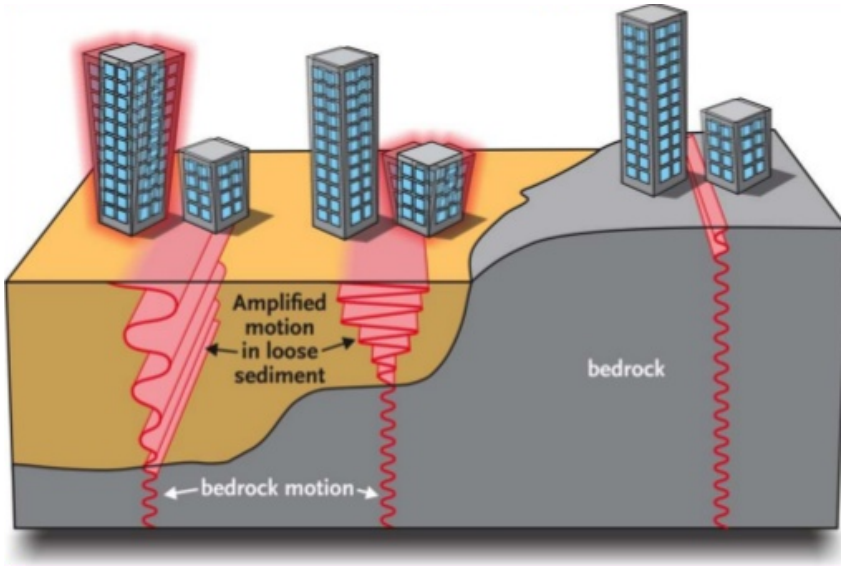
GLOBAL SEISMOMETER ARRAY



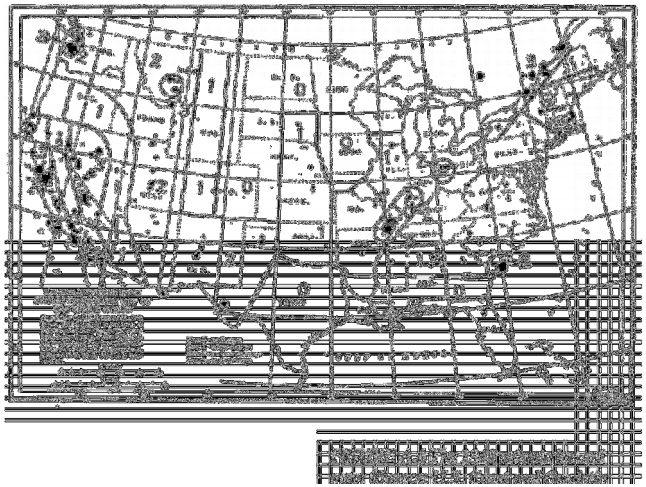

accelerogramme
acceleration [m/s²]
a max =3.66 m/s²
a min = -2.62 m/s²
time [s]
linear behavior
damping ratio: ζ
acc. [m/s²]
S a =2.31 m/s²
S a =7.00 m/s²
t [s]

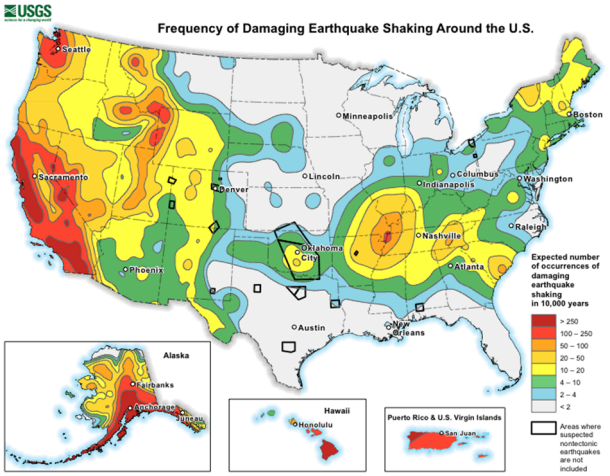

-X
-Z
+Z
+X




Amplified motion in loose sediment
bedrock
bedrock motion

EVOLUTION OF SEISMIC HAZARD MAPS





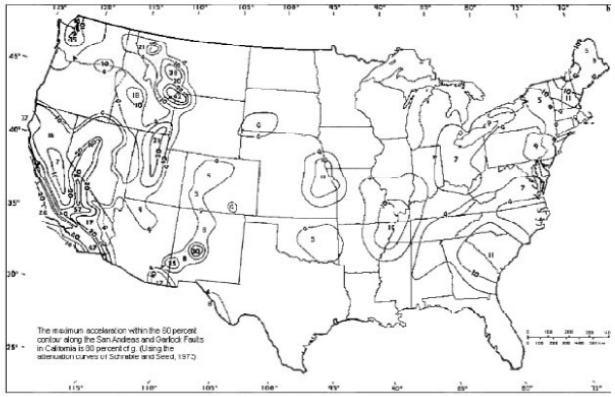


Figure 2-3 1976 USGS seismic accelerations map- estimated maximum accelera contours on rock, developed by Algermissen and Perkins. Republished courtesy ATC; originally published in ATC-3 06.

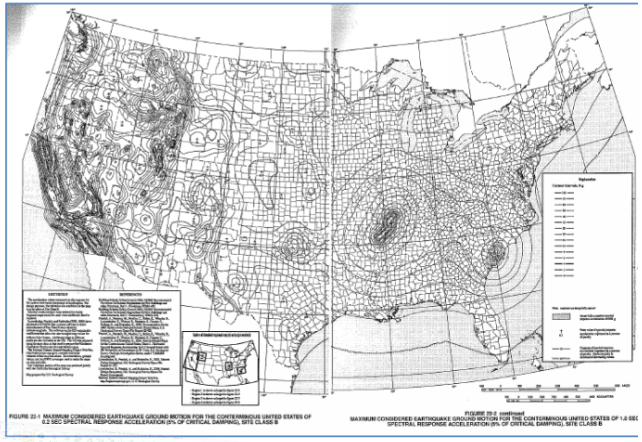
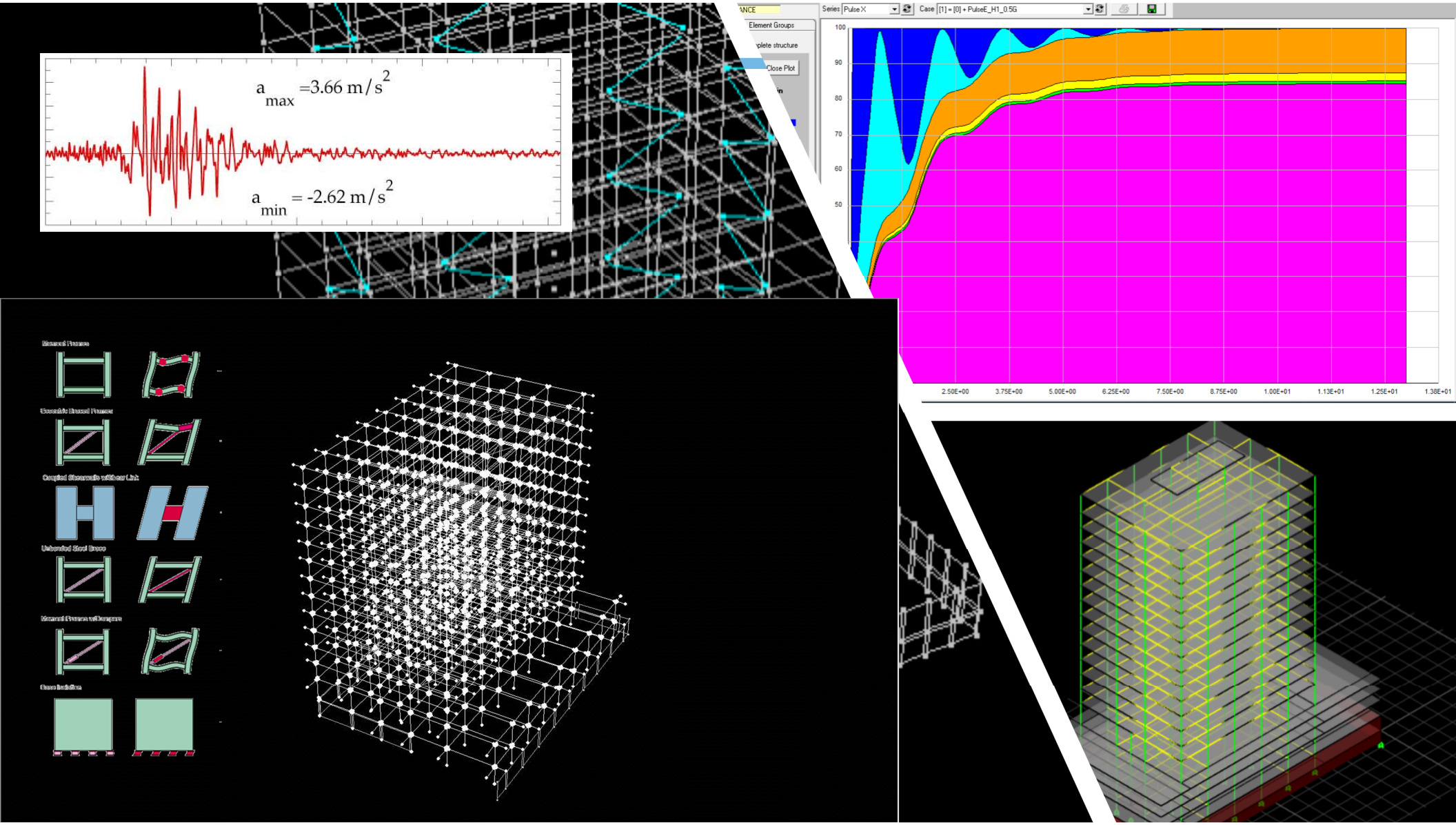


Figure 5: ASCE 7-05 Contour Map (ASCE7-05)

- Seismology
- Hazard Map Online tools (USGS, ASCE 7, SEAOC/OSHPD, ATC)
- Site Specific Hazard Investigations


$a_{max} = 3.66\ m/s^2$
$a_{min} = -2.62\ m/s^2$
Element Groups
Close Plot
Series PulseX
Case [1] = [0] + PulseE_H1_0.5G
100
90
80
70
60
50
2.50E+00
3.75E+00
5.00E+00
6.25E+00
7.50E+00
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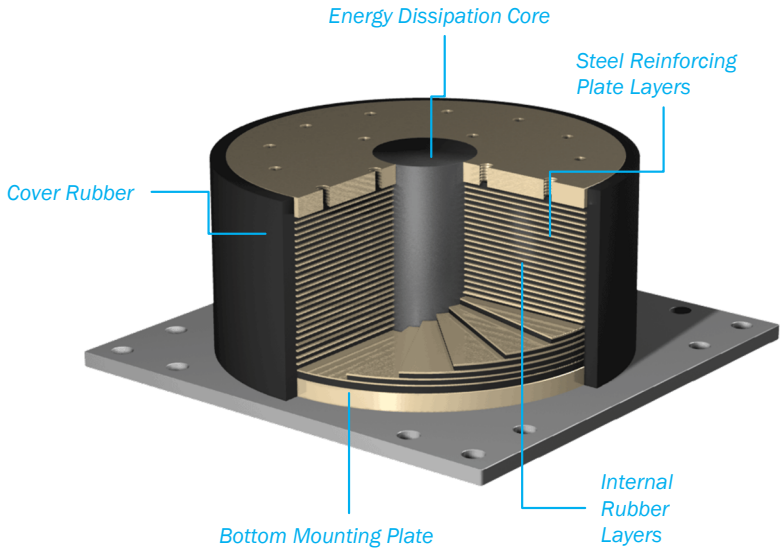
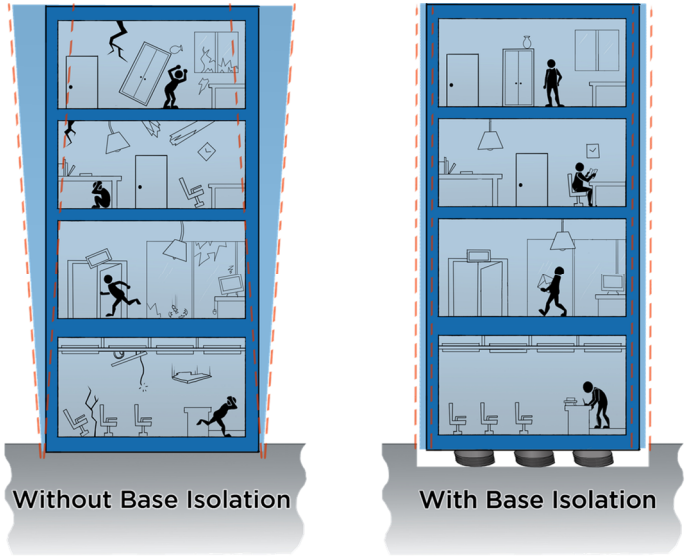
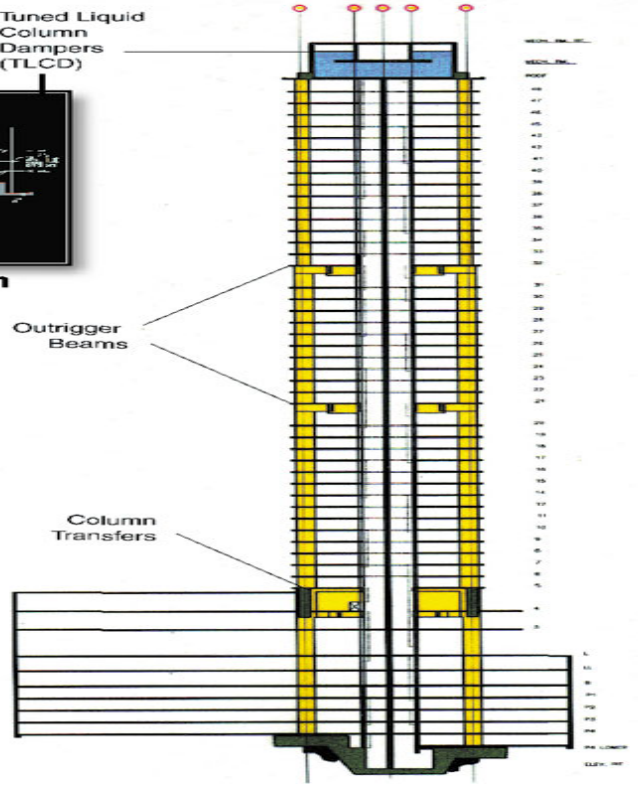
1.00E+01
1.13E+01
1.25E+01
1.38E+01

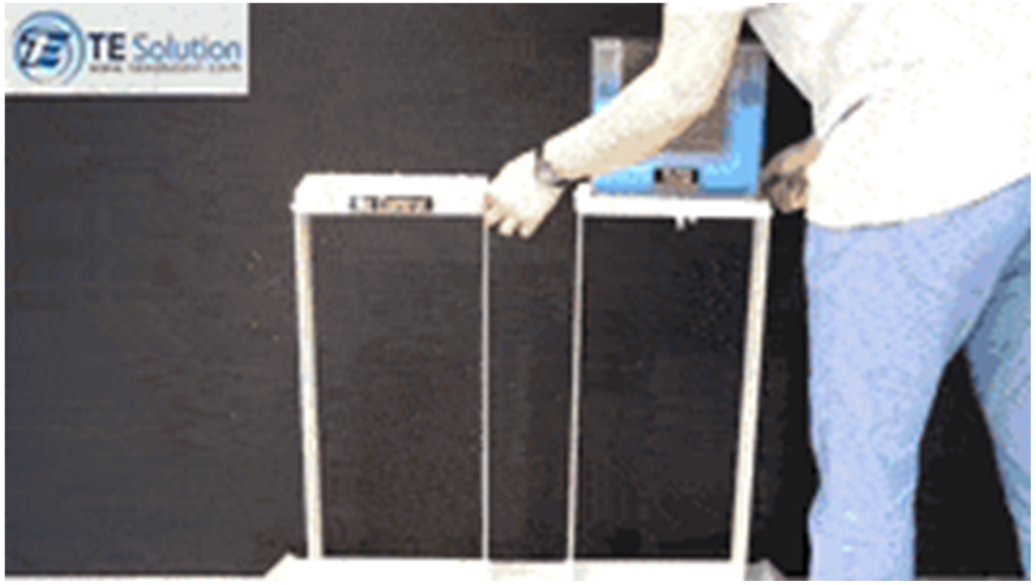

Energy Dissipation Core
Steel Reinforcing Plate Layers
Cover Rubber
Internal Rubber Layers
Bottom Mounting Plate


Without Base Isolation
With Base Isolation

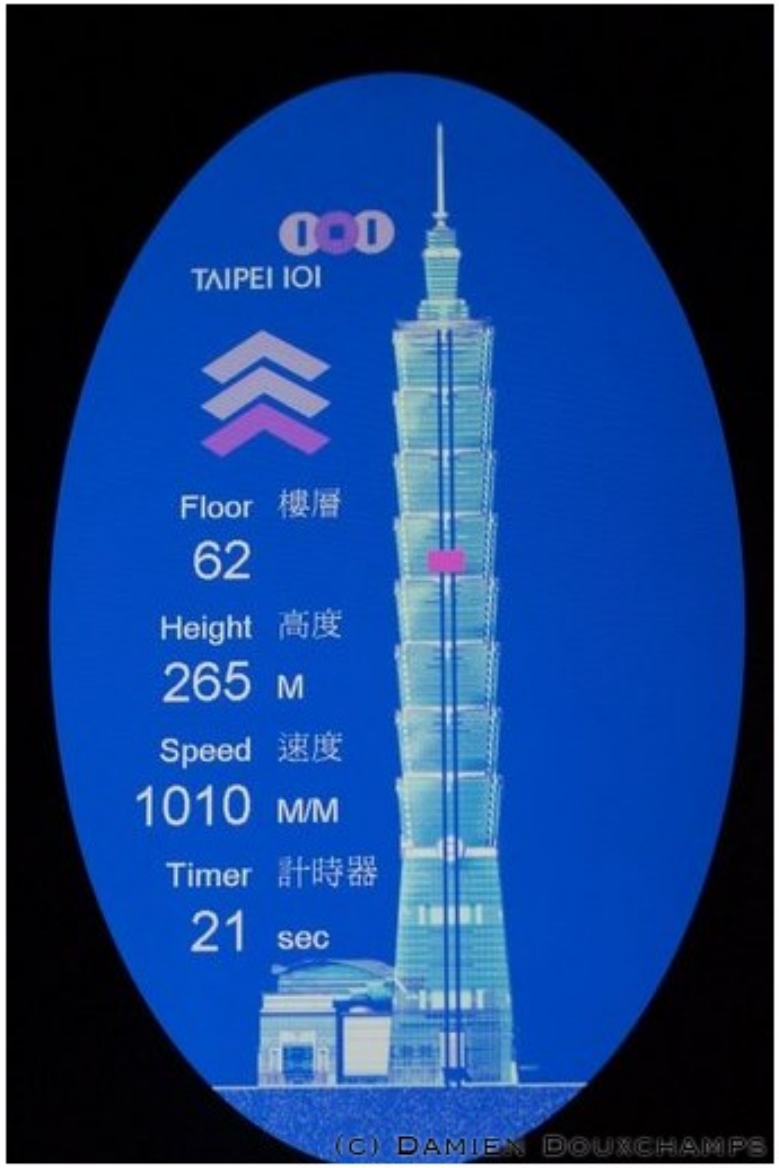
TUNED LIQUID DAMPER

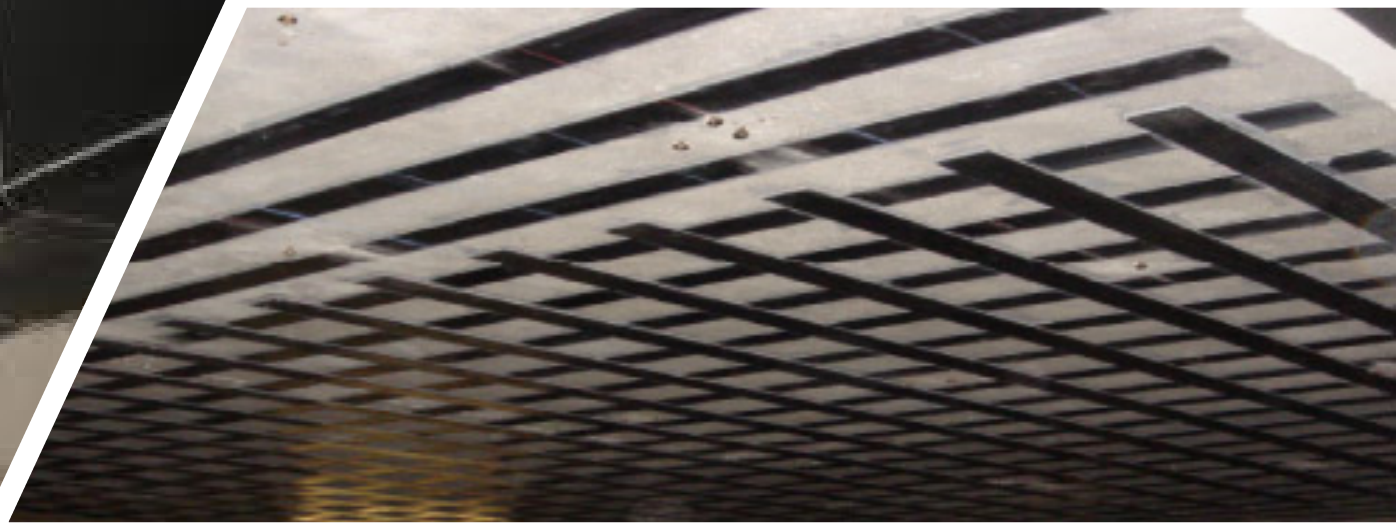
Tuned Liquid Column Damper Detail

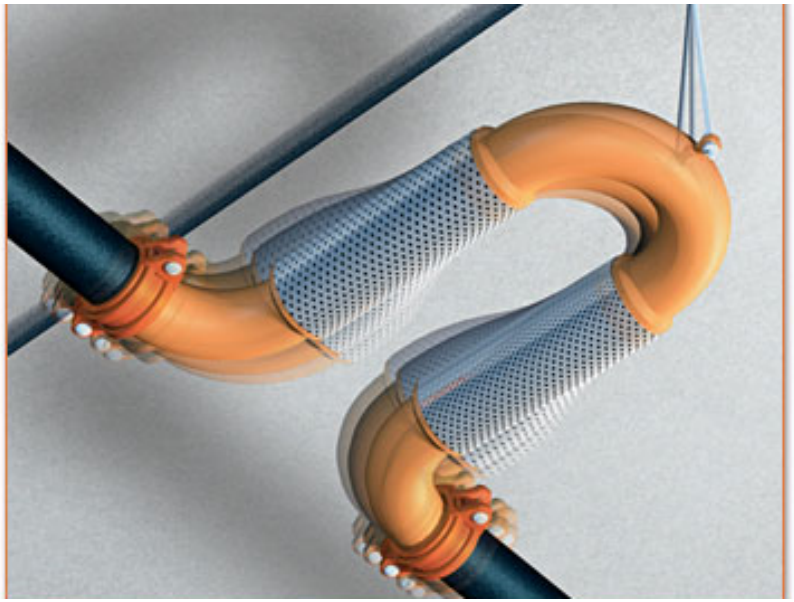


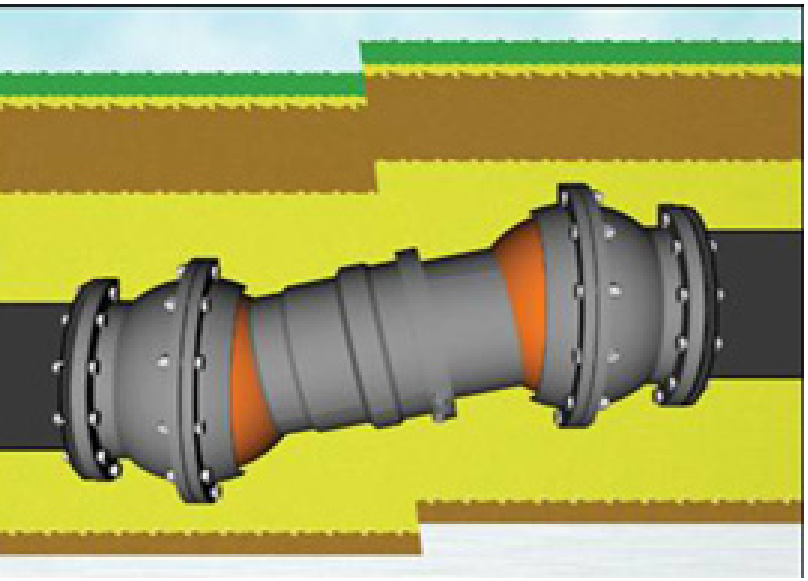


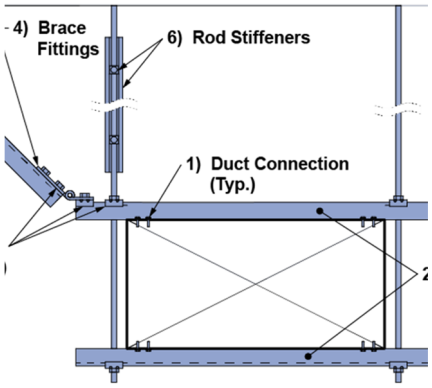
TUNED MASS DAMPER

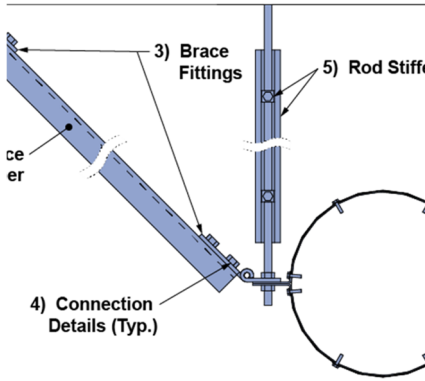









4) Brace Fittings
6) Rod Stiffeners
1) Duct Connection (Typ.)


3) Brace Fittings
4) Connection Details (Typ.)

WHAT EMPLOYERS LOOK FOR IN ENTRY LEVEL APPLICANTS

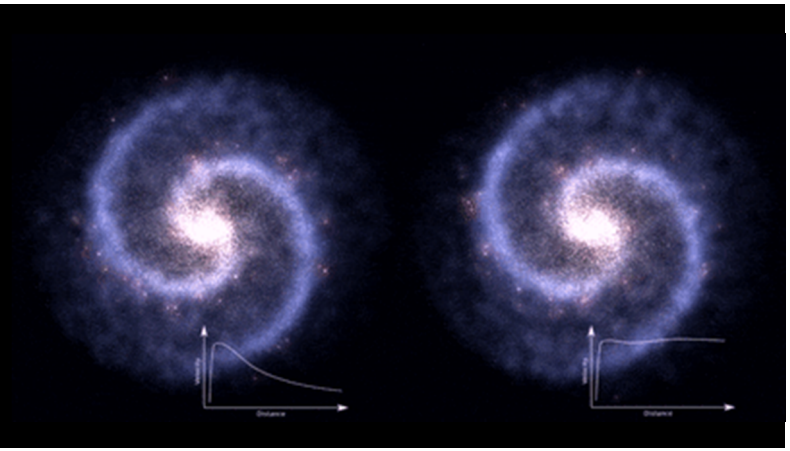
- School (Regional reputation)
- Master's Degree
- Transcripts . Coursework
- Grades . Relative
- Curiosity . Passion
- Communication Skills
- Technical Competence
- Trainability
- Self Motivation
- Professionalism . Maturity
- Relevant Internships

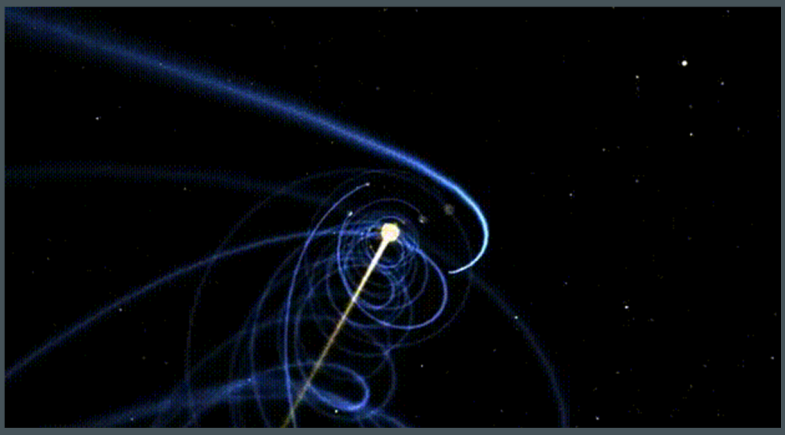
INTERVIEW PREP

- Do Some Research Beforehand re: Company
- Be Prepared w/ Questions of Your Own
- Careful w/ Online Research into Compensation (as reliable as “Average Weather in SF/LA”)
- Take Office Tour
- Talk to a Younger Engineer
- As About the Various Topics Discussed Previously
- Schedule Interviews in Bundles When Possible (Multiple Offers Give you Some Leverage)
- (Don’t Over) Negotiate

WILL YOU BE READY?

- Zzzzzz! Huh, wha'?
- Don't care
- Thanks, but no thanks
- Doesn't seem hard
- Whoa, that seems way too complicated
- I want to be ready, tell me more..
  - What concepts do I REALLY need to know?





ISAAC NEWTON

- Key figure of the Enlightenment
- During QUARANTINE (Great Plague of London)….
  - Calculus
  - Optics
  - Mechanics, Gravitation, Laws of Motion

VITAL KNOWLEDGE

- STATICS & MECHANICS
  - STATIC EQUILIBRIUM
  - INTERNAL FORCES
  - MATH: ALGEBRA . TRIGONOMETRY . MATRIX
- DYNAMICS
  - HARMONIC OSCILLATION
  - VIBRATIONS, MODES, WAVES
  - MATH: CALCULUS . FOURIER

How do bunnies behave in the wild

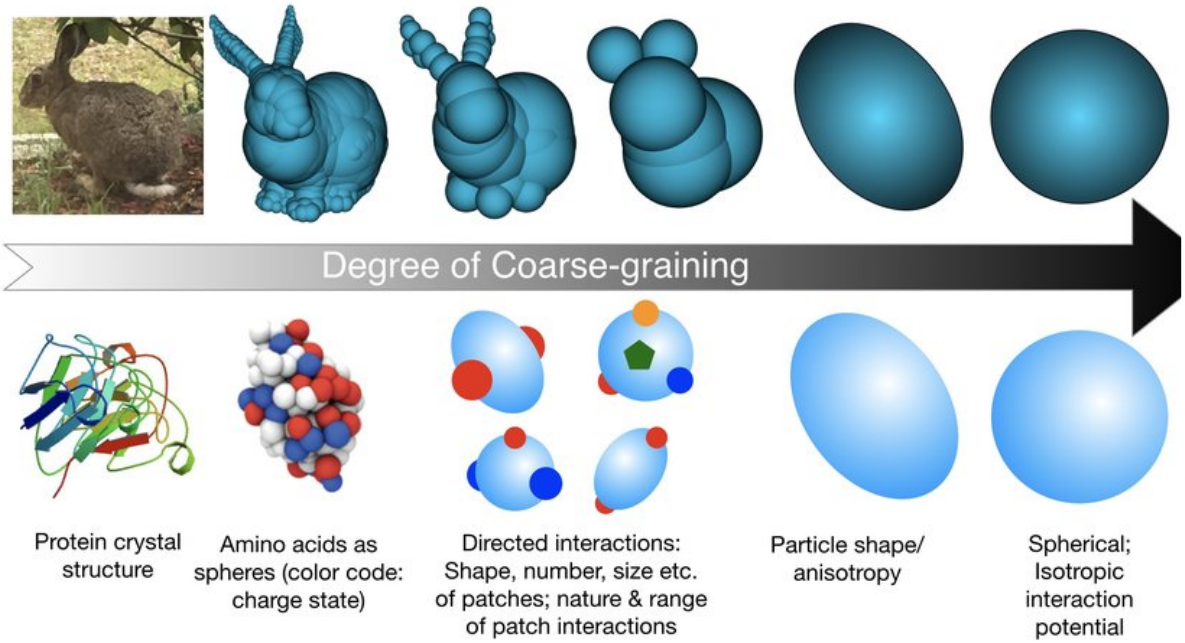
How do bunnies jump so well

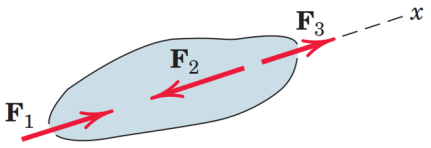
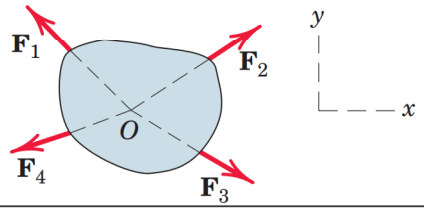
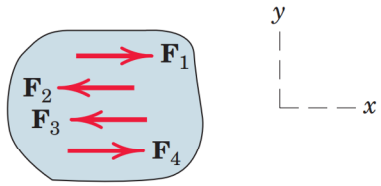
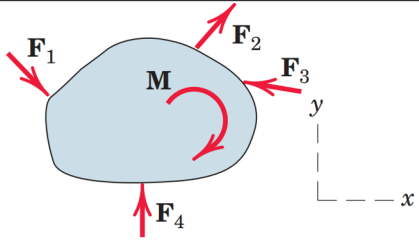
How do you know when you've spotted a bunny

Where is a bunny's center of mass

How do you know when you've spotted a bunny

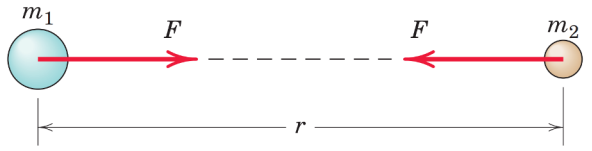
How much heat energy does a bunny produce

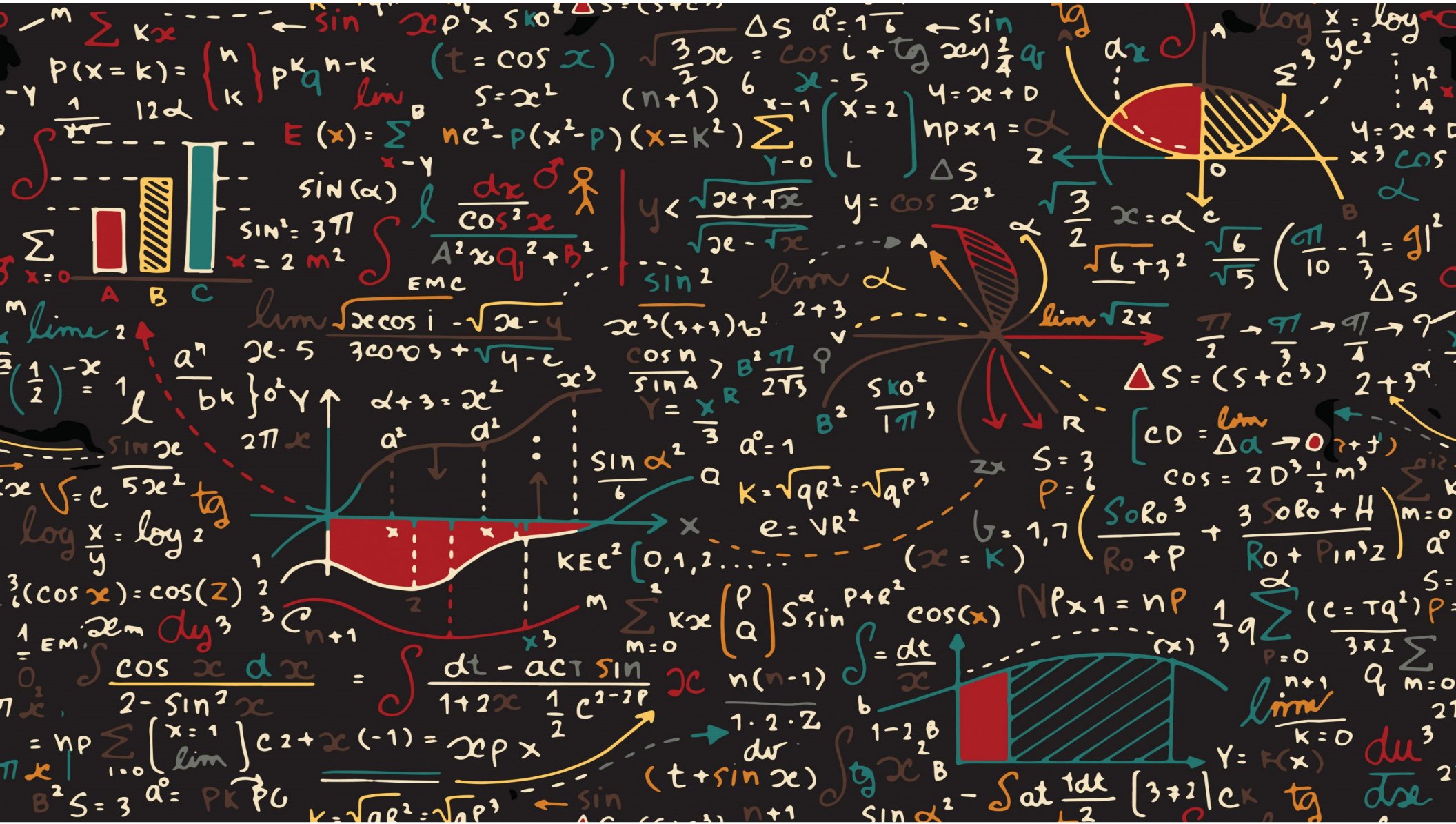


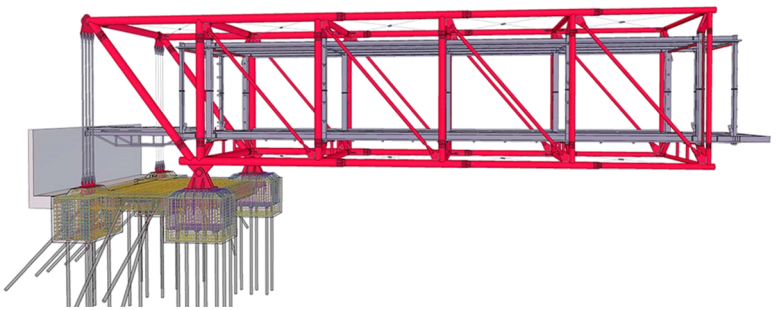
CATEGORIES OF EQUILIBRIUM IN TWO DIMENSIONS		
Force System	Free-Body Diagram	Independent Equations
1. Collinear		$\Sigma F_x = 0$
2. Concurrent at a point		$\Sigma F_x = 0$ $\Sigma F_y = 0$
3. Parallel		$\Sigma F_x = 0$ $\quad \Sigma M_z = 0$
4. General		$\Sigma F_x = 0$ $\quad \Sigma M_z = 0$ $\Sigma F_y = 0$

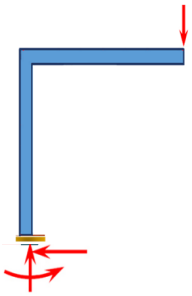
$$F = G\frac{m_1 m_2}{r^2}$$

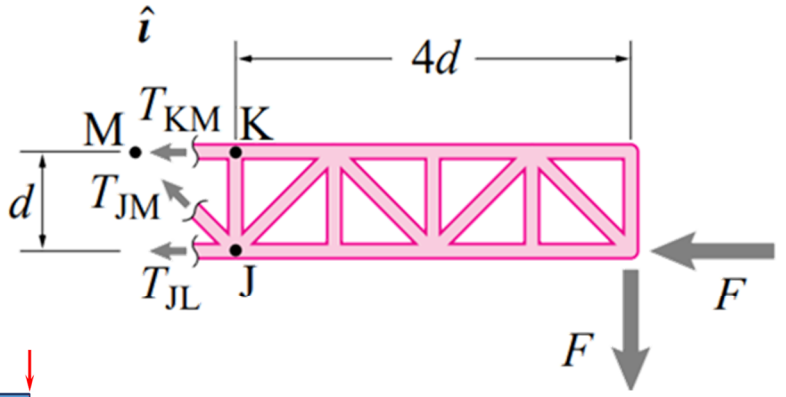
$$\mathbf{F} = m\mathbf{a}$$

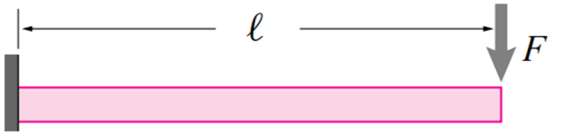


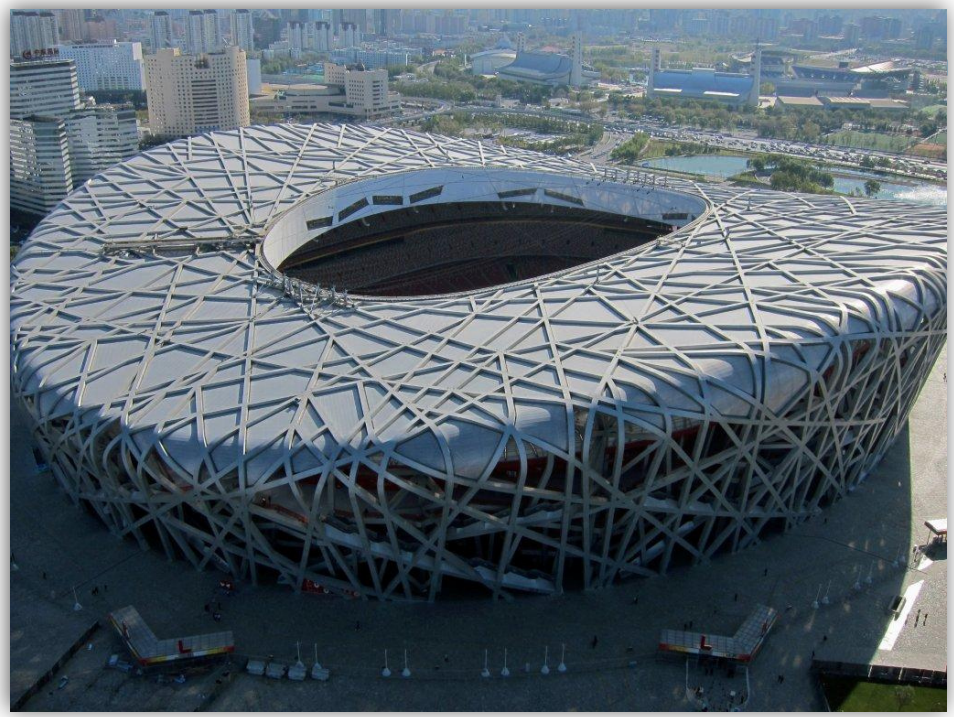

A B C

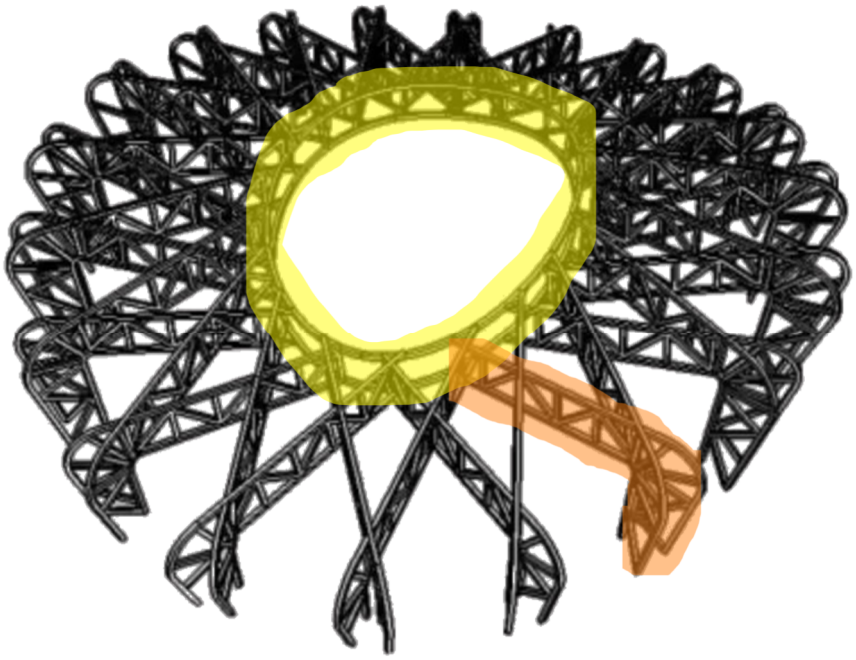


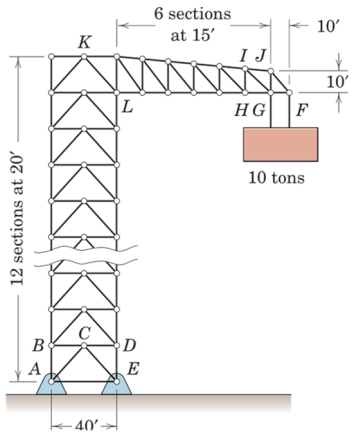


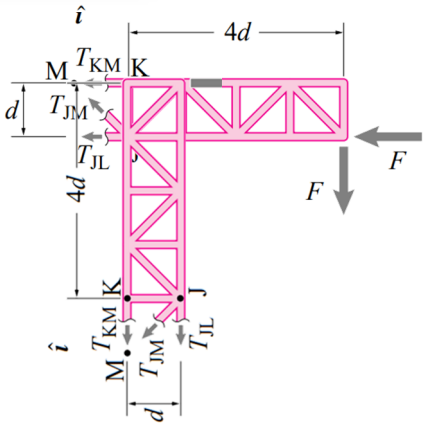

$\hat{\boldsymbol{i}}$
4d
M
T_{KM}
K
d
T_{JM}
T_{JL}
J
F
F

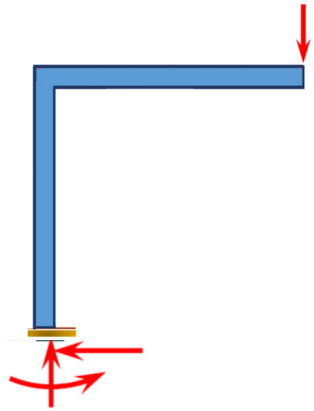

ℓ
F

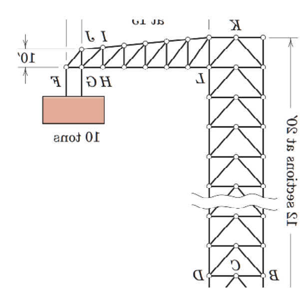


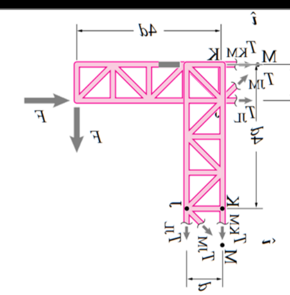


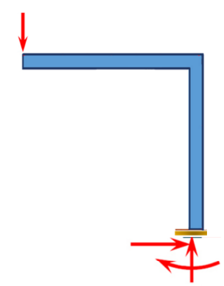

6 sections
at 15′
10′
K
I J
10′
L
H G
F
10 tons
12 sections at 20′
B
C
D
A
E
40′


4d
M
K
d
F
F
4d
K
J
M
d

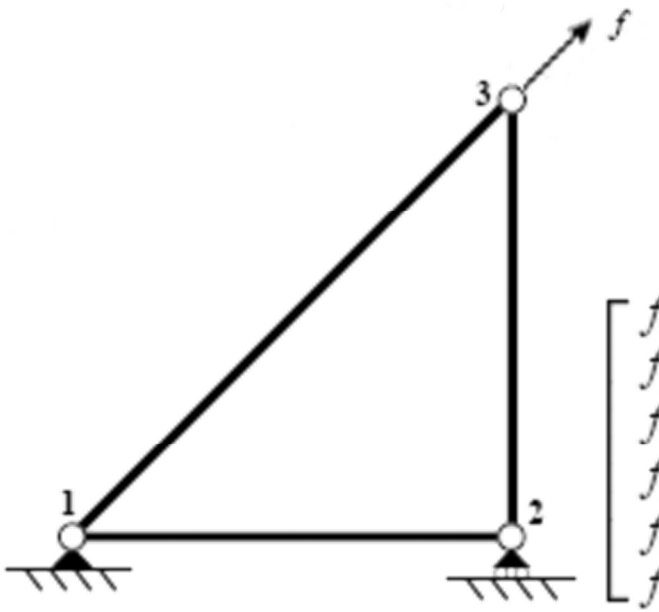








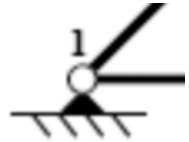
FORCE FLOW IN STRUCTURES – MATRIX ANALYSIS



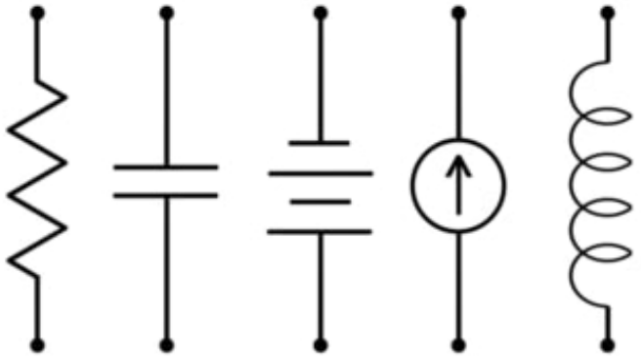
$$\mathbf{f} = \mathbf{K}\mathbf{u}$$

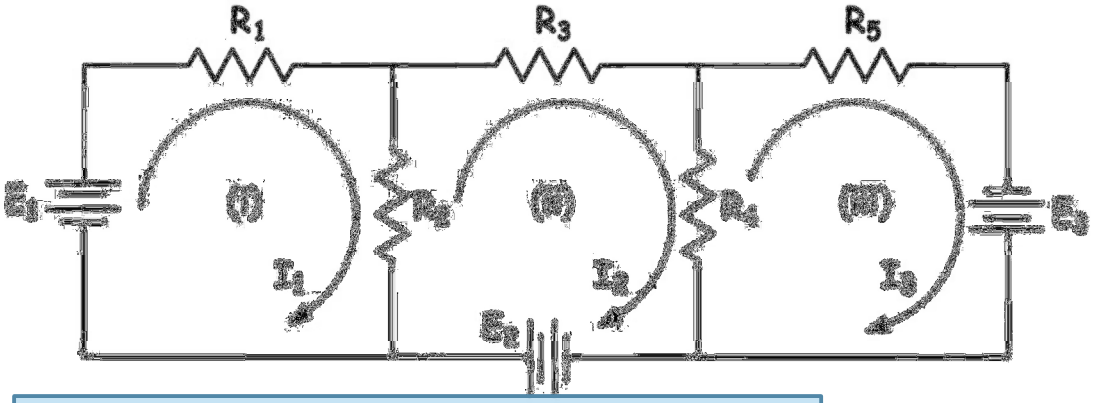
Or

$$\begin{bmatrix} f_{x1} \\ f_{y1} \\ f_{x2} \\ f_{y2} \\ f_{x3} \\ f_{y3} \end{bmatrix} = \begin{bmatrix} k_{11} & k_{12} & k_{13} & k_{14} & k_{15} & k_{16} \\ k_{21} & k_{22} & k_{23} & k_{24} & k_{25} & k_{26} \\ k_{31} & k_{32} & k_{33} & k_{34} & k_{35} & k_{36} \\ k_{41} & k_{42} & k_{43} & k_{44} & k_{45} & k_{46} \\ k_{51} & k_{52} & k_{53} & k_{54} & k_{55} & k_{56} \\ k_{61} & k_{62} & k_{63} & k_{64} & k_{65} & k_{66} \end{bmatrix} \begin{bmatrix} u_{x1} \\ u_{y1} \\ u_{x2} \\ u_{y2} \\ u_{x3} \\ u_{y3} \end{bmatrix}$$



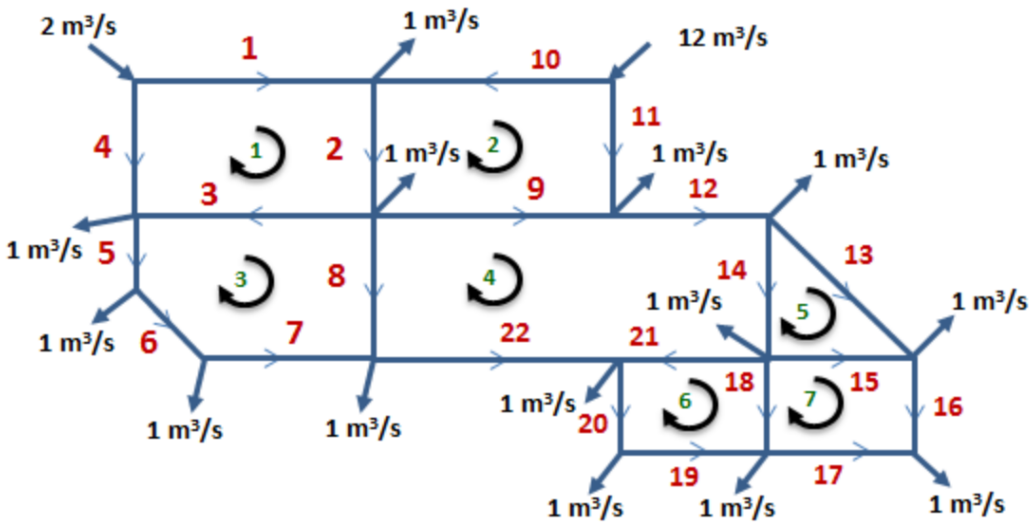
ELECTRICAL FLOW IN CIRCUITS – MATRIX ANALYSIS



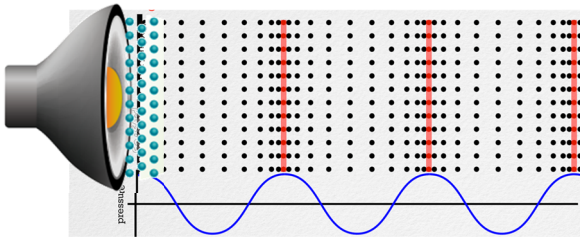


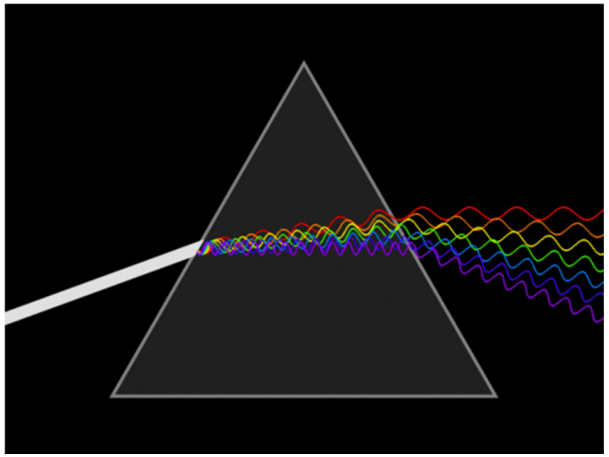
$$\begin{bmatrix} (R_1+R_2) & -R_2 & 0 \\ -R_2 & (R_2+R_3+R_4) & -R_4 \\ 0 & -R_4 & (R_4+R_5) \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} E_1 \\ E_2 \\ E_3 \end{bmatrix}$$

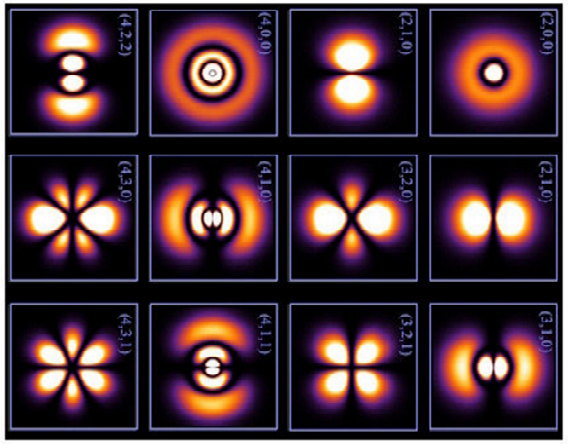
FLUID FLOW IN PIPING NETWORKS – MATRIX ANALYSIS

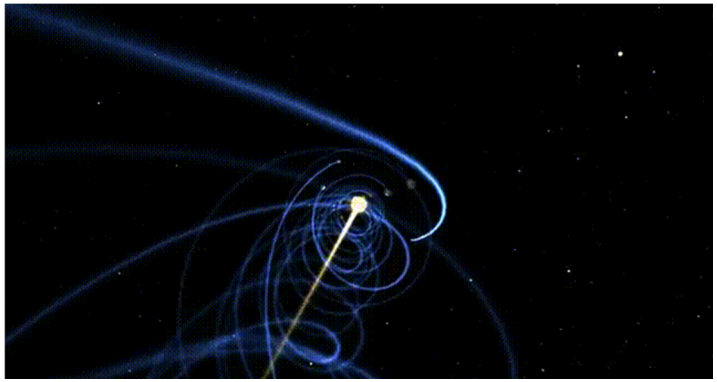


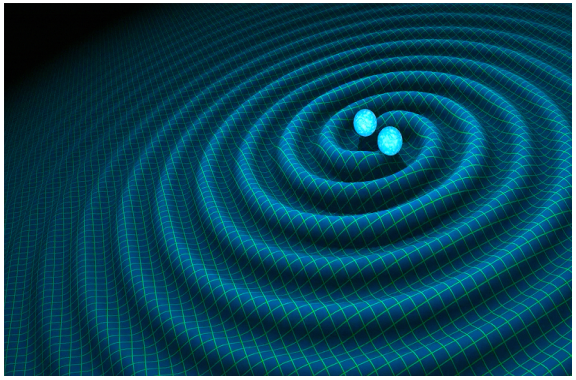
	A	B	C	D	E	F	G	H	I	J	K	L
93	Iteration											
94	5	Pipe	Flow	Length	Diameter	e/D	Velocity	Reynold's	Friction			
95			m3/s	m	m		m/s	Number	Factor, f	K	hL	nHL/Q
96		1	0.205	300	0.30	0.00087	2.90	869910	0.019	199	8.34	81.42
97		2	0.095	250	0.25	0.00104	1.94	483995	0.021	435	3.93	82.61
98		5	0.080	350	0.20	0.00130	2.54	507484	0.022	1949	12.38	310.66
99		3	0.125	125	0.20	0.00130	3.99	797381	0.021	689	10.82	172.72
100		6	0.033	350	0.20	0.00130	1.05	210734	0.022	2010	2.20	133.09
101		7	0.030	125	0.20	0.00130	0.95	189174	0.022	722	0.64	42.90
102		4	0.095	300	0.20	0.00130	3.02	604994	0.021	1663	15.02	316.17
103		8	0.008	125	0.15	0.00173	0.44	66630	0.025	3455	0.21	54.24
104		9	0.087	350	0.20	0.00130	2.78	555021	0.022	1944	14.78	339.04
105		10	0.063	125	0.15	0.00173	3.55	533211	0.023	3133	12.36	393.64
106												
107		Coefficient Matrix					Inverse				F	DQ
108			707.16	-172.72	-54.24		1.53E-03	4.32E-04	1.53E-04		0.00	0.00000
109			-172.72	659.37	-133.09		4.32E-04	1.68E-03	2.69E-04		0.00	0.00000
110			-54.24	-133.09	920.01		1.53E-04	2.69E-04	1.13E-03		0.00	0.00000



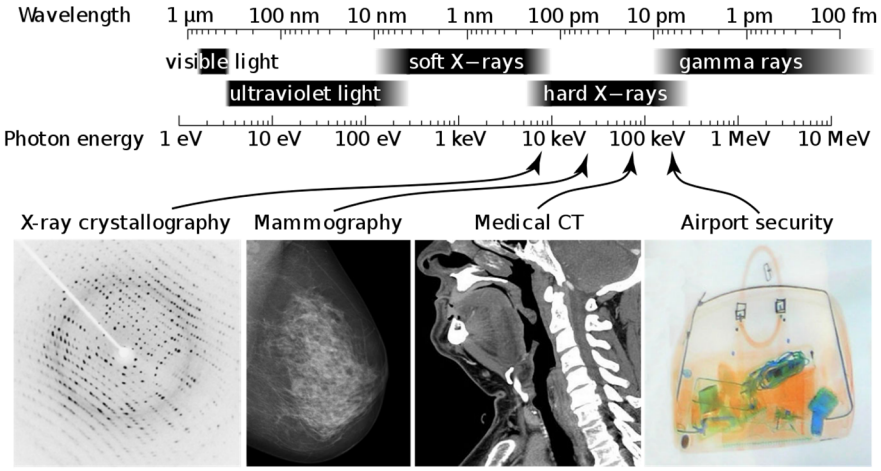


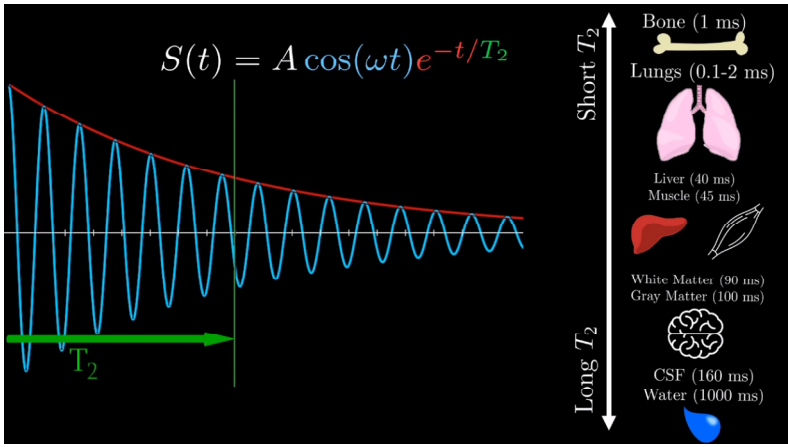

(4,2,2)
(4,0,0)
(2,1,0)
(2,0,0)
(4,3,0)
(4,1,0)
(3,2,0)
(2,1,0)
(4,3,1)
(4,1,1)
(3,2,1)
(3,1,0)

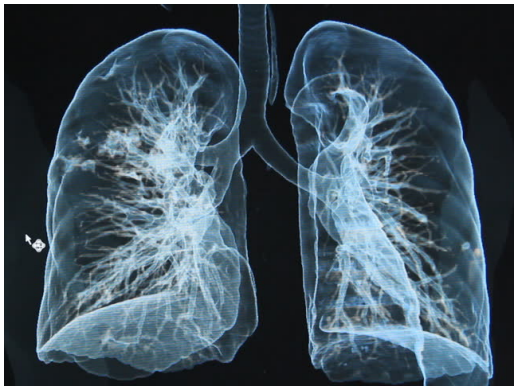


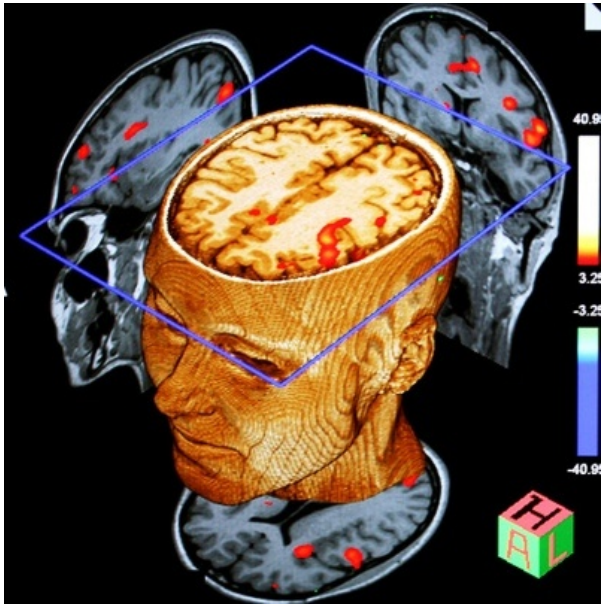


X-RAYS & MRI'S


Wavelength
1 µm
100 nm
10 nm
1 nm
100 pm
10 pm
1 pm
100 fm
visible light
soft X−rays
gamma rays
ultraviolet light
hard X−rays
Photon energy
1 eV
10 eV
100 eV
1 keV
10 keV
100 keV
1 MeV
10 MeV
X-ray crystallography
Mammography
Medical CT
Airport security

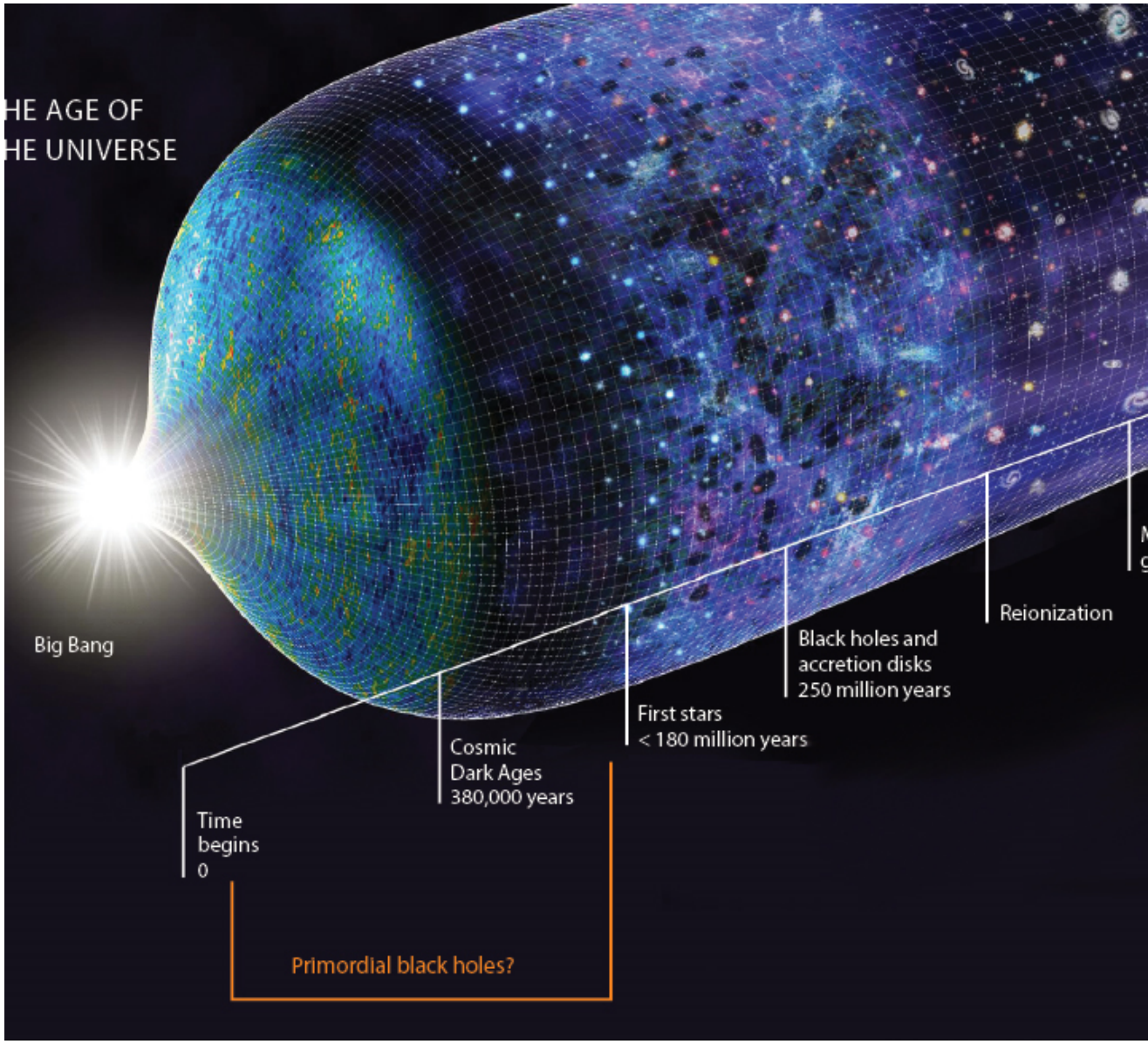

$S(t) = A\cos(\omega t)e^{-t/T_2}$
T_2
Short T_2
Long T_2
Bone (1 ms)
Lungs (0.1-2 ms)
Liver (40 ms)
Muscle (45 ms)
White Matter (90 ms)
Gray Matter (100 ms)
CSF (160 ms)
Water (1000 ms)

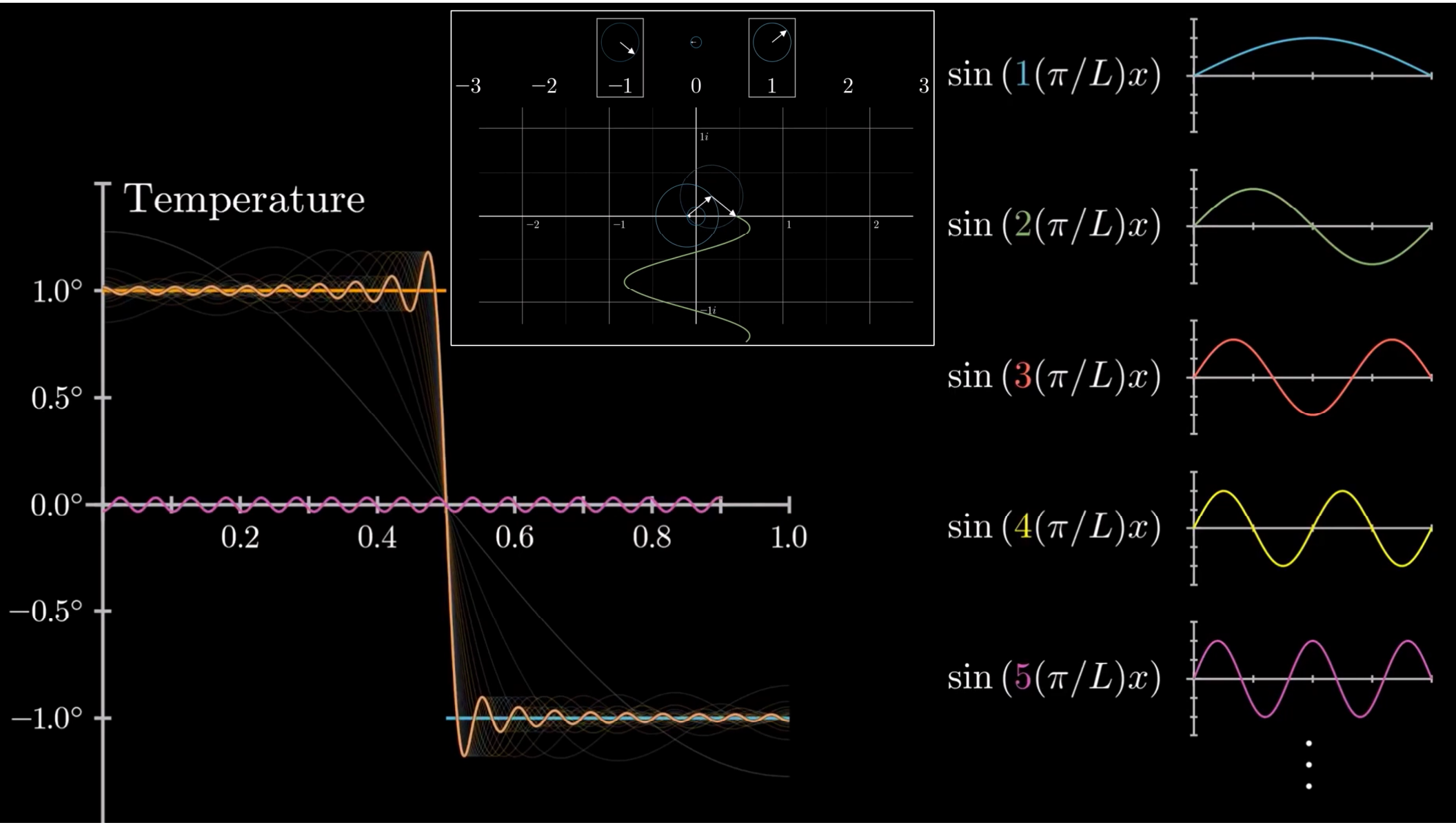


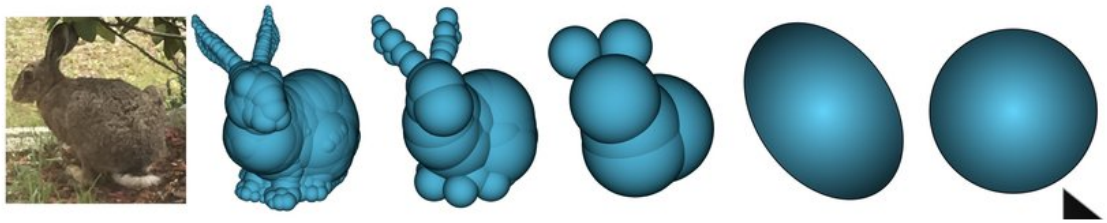

40.9
3.2
-3.2
-40.9
H
A
L

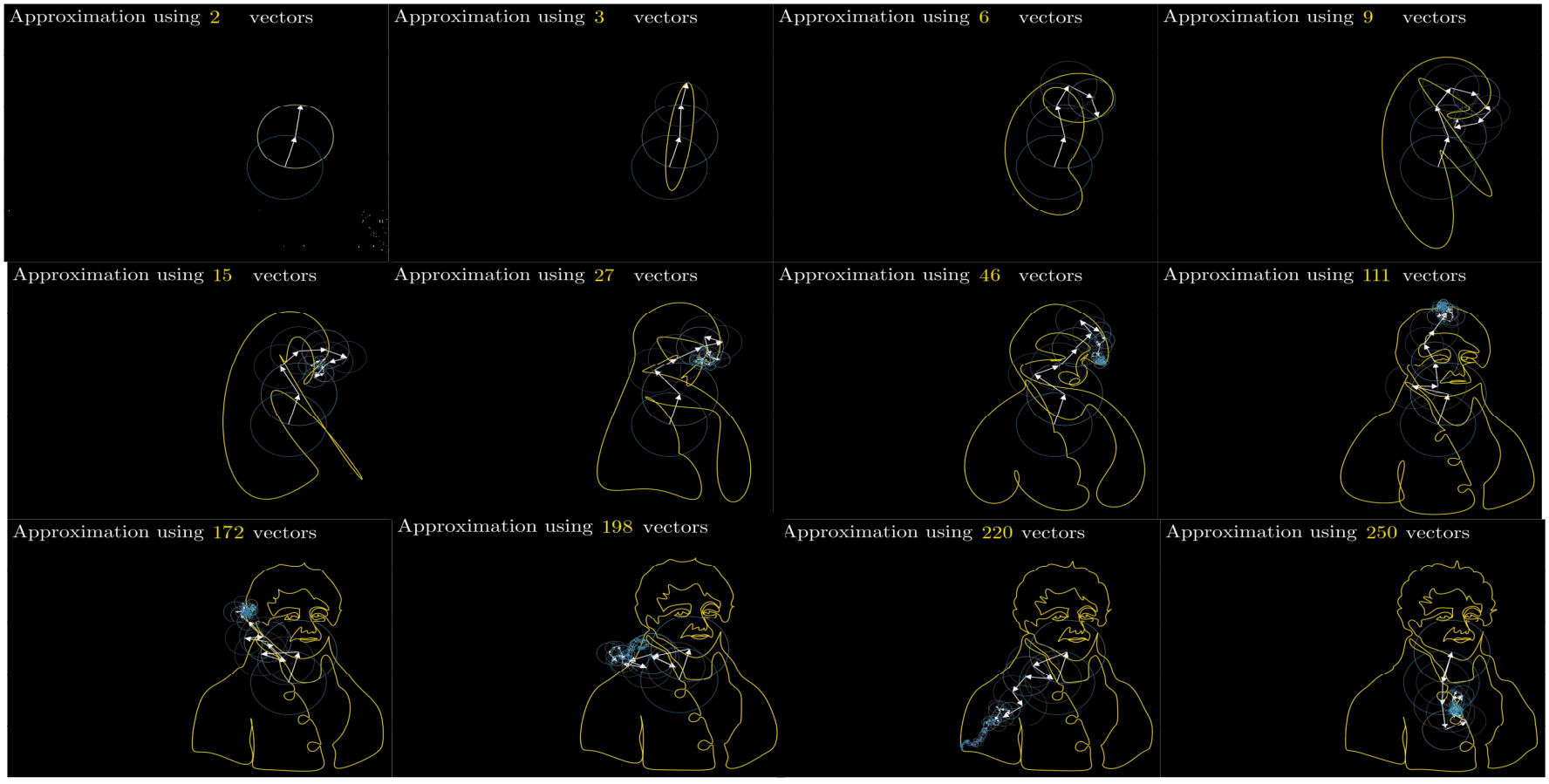
LIGO – GRAVITY WAVE DETECTOR

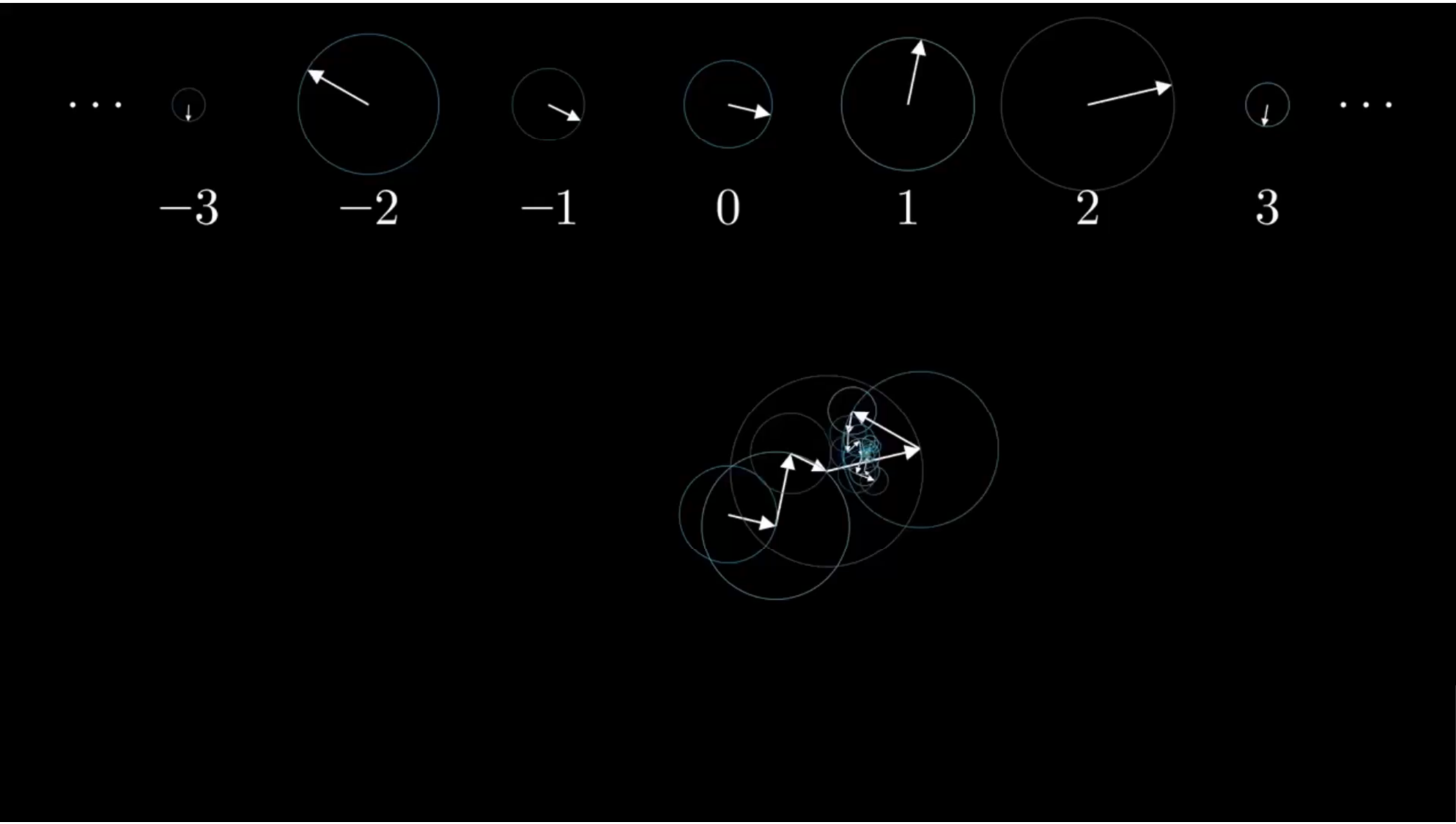
- Gravitational Wave Detector
- Look past Cosmic Dark Ages

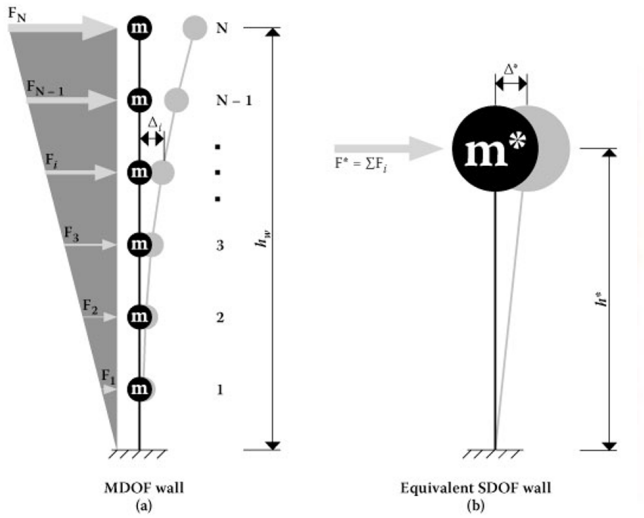



Temperature
1.0°
0.5°
0.0°
−0.5°
−1.0°
0.2
0.4
0.6
0.8
1.0
−3
−2
−1
0
1
2
3
1i
−1i
sin (1(π/L)x)
sin (2(π/L)x)
sin (3(π/L)x)
sin (4(π/L)x)
sin (5(π/L)x)



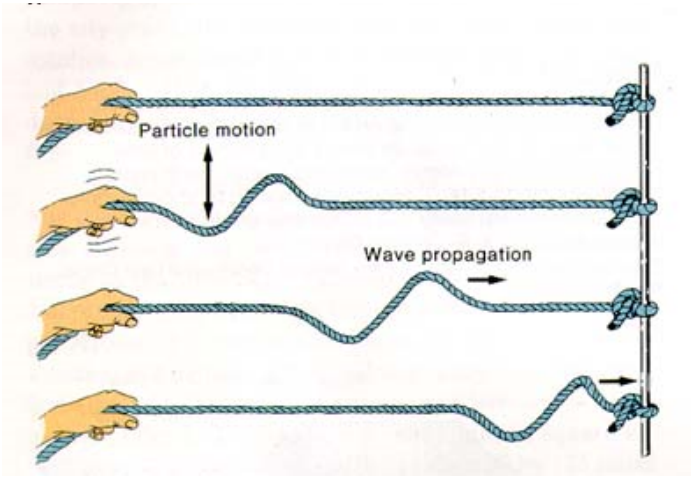

Approximation using 2 vectors
Approximation using 3 vectors
Approximation using 6 vectors
Approximation using 9 vectors
Approximation using 15 vectors
Approximation using 27 vectors
Approximation using 46 vectors
Approximation using 111 vectors
Approximation using 172 vectors
Approximation using 198 vectors
Approximation using 220 vectors
Approximation using 250 vectors

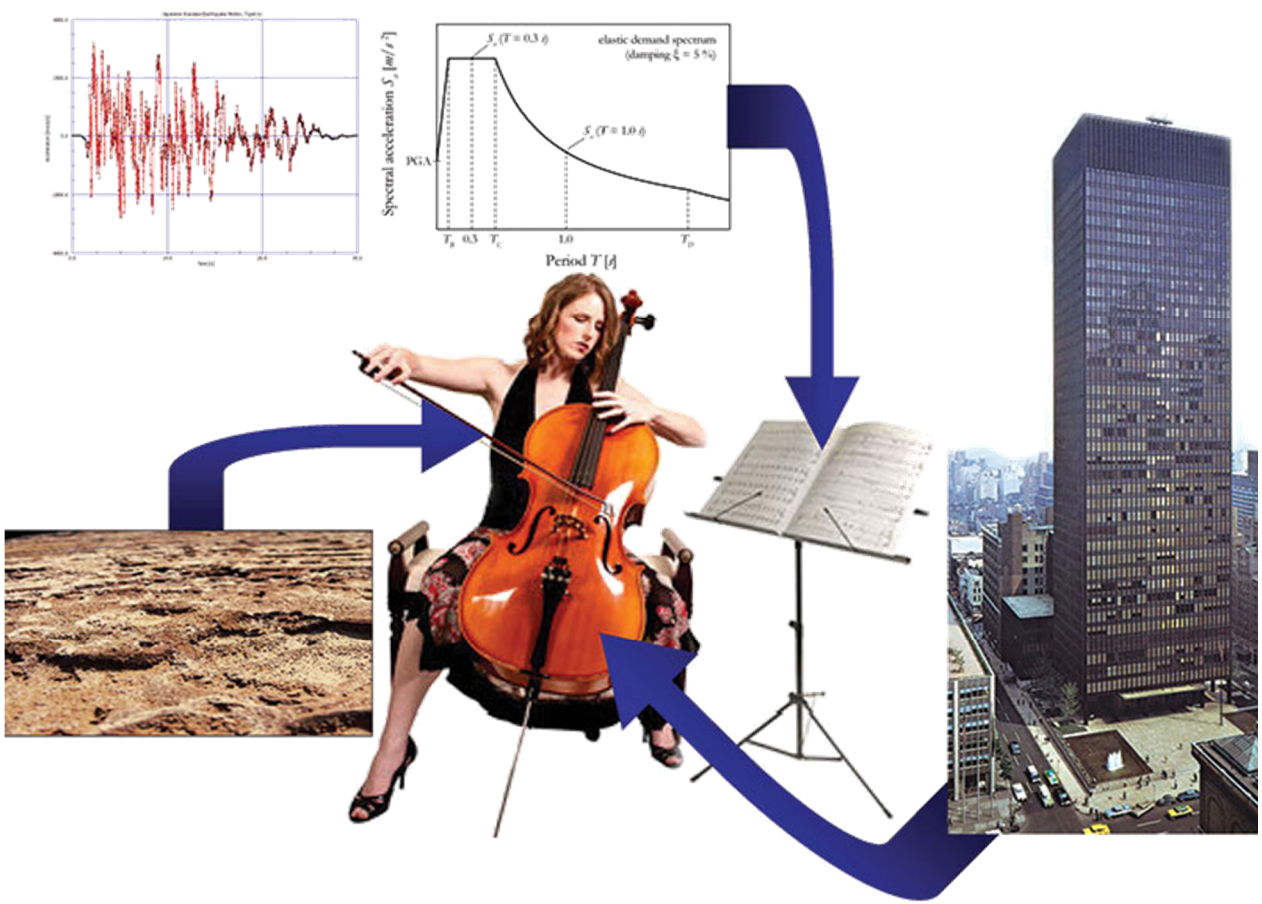

−3
−2
−1
0
1
2
3



MDOF wall
(a)

Equivalent SDOF wall
(b)





ONLINE REFERENCES

- Youtube Resources that could really help
  - Math – 3Blue1Brown, Numberphile, Stand-up Maths
  - Engineering – The Efficient Engineer
  - Many online courses for free from all over the world
- For fun:
  - Cosmology – David Butler, PBS Spacetime, SpaceRip
  - Science – Veritasium, Professor Dave Explains, World Science Festival, Minute Physics, Stated Clearly
  - Podcasts - Mindscape

LAST WORDS

- Prioritize learning the concepts first, the rest will come easier
- The future is contingent on the now, be diligent
  - Be present in class
  - Ask questions, Go to office hours
  - Focus on learning and the grades will likely follow
- I am volunteering personal time for any questions you may have on any of the topics discussed today. ET has my contact and can share it with you.